FEB 13 1888

PRICE 15 CENTS

FEBRUARY 11, 1888.

# THE AMERICAN ARCHITECT AND BUILDING NEWS

VOL XXIII. REGULAR EDITION NO. 633.

ARCHITECTURE

ENGINEERING

DECORATION

CONSTRUCTION

TICKNOR & COMPANY

BOSTON MASS.

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Houses at Utica, and Clinton, N. Y.
Street in St. Lizier, Ariege, France.



**REVIEW OF THE PRINCIPLES OF SANITARY PLUMBING AS NOW ACCEPTED BY ALL LEADING SANITARIANS.**

THE main object to be attained is the complete removal of waste matters from the premises the instant they are generated. This can only be accomplished by observing the following rules:— (1.) Avoid all cesspools. (2.) Make all waste-passages as small as possible to effect their purposes. (3.) Construct every fixture on the principle of the flush-tank. (4.) Make every trap seal-retaining and self-scouring. (5.) Make all joints tight. (6.) Select the simplest appliances and the simplest system consistent with safety. These rules are self-evident enough to be accepted as plumbing axioms, and are sufficient to produce perfect work. The "Sanitas" Appliances have been constructed with a view to their fulfilment in every respect, and an examination of the steps leading to the development of these appliances will best illustrate the principles of Sanitary Plumbing, showing the faults which should be avoided, and the objects which should be sought.

Beginning with the trap: In the first place mechanical seals have been discarded as being unreliable, unnecessary, and as obstructing the water-way. We start with the simplest form of water-seal trap, the ordinary S-trap. This

trap answers all our requirements except that it has no power to retain its seal under the variations of atmospheric pressure occuring within the waste-pipes. To remedy this deficiency the pot-trap was developed from the S-trap by simply enlarging its upcast limb, a sufficient enlargement gives it a temporary power of resistance, but creates a cesspool having no self-cleansing power and, accordingly, the trap clogs, under sinks, with

grease and ultimately loses its original resisting power. To avoid this difficulty we have turned the pot-trap on its side and reduced the size of its body. This permits the air to pass through the trap above the water without driving the latter out

before it, as would be the case with a perpendicular body equally reduced in diameter. To still further increase the power of resistance to siphonage the body was next bent into a quadrangle, giving several reflecting surfaces, which throw back this water under siphoning action while they allow the air to escape, and, finally, the two parallel sides of the quadrangle were merged into a single body having a reflecting partition and a large clean-out cap. This gives us the perfected Sanitas-Trap, which

has proved itself to be both anti-siphonic in properly arranged plumbing-work and substantially self-cleansing either with or without venting. It is more resisting than a vented S-trap.

SANITAS

PLUMBING APPLIANCES

The Sanitas is a Scientific System of Plumbing, having Simplicity and Safety for its Basis. It is also by far the most Economical System.

Avoid Infringements and Imitations which are described as being "as good as the 'Sanitas;'" they are not, they are very inferior as well as illegal.

Considering next the Lavatory. These should always be constructed on the principle of the flush-tank, their discharges filling the water-passages "full-bore," so as to keep them clean. The overflow and outlet passages should be combined in the form of a stand-pipe, thus doing away with the usual foul, inaccessible and badly jointed lead overflow-pipe, and the troublesome and dirty plug and chain. The stand-pipe should be operated by a simple mechanism above the slab, for convenience and cleanliness, requiring but a single movement of the hand, and all parts should be of solid and durable construction, while the stand-pipe should be easily detachable for cleansing. The Sanitas Lavatories are all constructed after this principle, and they are the first ever so constructed. The stand-pipes are made of either plated metal or of earthenware, like the fixture itself, and the whole device produces a very ornamental effect, especially when decorated in colors to correspond with the decoration of the earthenware bowl. Finally, the ideal water-closet should have the simplicity of the short-hopper, with the sanitary advantages and convenience of the improved modern closets. More than this, it should be practically noiseless, anti-siphonic, quick-acting, self-sealing, and free from spattering or waste of water. These desiderata have been attained in the Sanitas Water-Closet of which we sketch the outline in section. The supply-pipe between the cistern and the closet discharges into the latter below the level of its standing water, and being without air-pipe, stands permanently full of water, hence the action is instantaneous and the noise of flushing is deadened. This and the peculiar construction of the flushing-rim and water-supply passages cause the waste to be discharged with wonderful speed and effectiveness; and at the same time so quietly that with the cover down and the toilet-room door closed, no sound of flushing can be heard from without. The closet is highly ornamental in appearance, hence no other wood-work is required than the seat and cover, and these may be supported directly on the earthenware itself, which is constructed with this in view. The Sanitas System, taken together, is the most economical as well as the only safe system of plumbing, as avoiding the dangers and complication of special trap venting. Whether vented or not it is now admitted that safety requires a trap to be *anti-siphonic*, the vent-pipe alone not being reliable. The Sanitas Trap holds sufficient water to resist, when properly set, any *back pressure* that can occur in good plumbing with properly vented soil-pipes. For more detailed description and illustration of the Sanitas Appliances, see our other Advertisements and the Circulars of

**THE SANITAS MANUFACTURING CO., BOSTON.**

# THE AMERICAN ARCHITECT AND BUILDING NEWS.

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FEBRUARY 11, 1888.

Entered at the Post-Office at Boston as second-class matter.


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THE Italian Government has taken a step which was long ago suggested, as a retaliation for the American imposition of a duty upon works of art. Scores of clever artists in Italy have lived for many years on the proceeds of the pictures, copies or originals, which they sold to American visitors. These were naturally their best customers, as Americans have no such opportunity as is enjoyed by the citizens of other countries for seeing great paintings in the original, and are glad to get good copies; and the suppression of the business by the infliction of a heavy duty is said to have caused a good deal of distress to very worthy people. An urgent appeal was made a year or more ago to the Italian Government to impose an export duty on works of art, in return for the American import duty, but it seems to have reflected that this would not help the Italian painters, and has taken the more sensible, as well as less violent course of laying a tax on exports of antique objects of art. At present, antiquities are admitted to the United States free of duty, as representing an industry which obviously does not need protection, and an immense number of them are annually imported by tourists and dealers in bric-à-brac. The Italian Government, therefore, desiring to relieve its living artists by handicapping their antique competitors, has voted to impose an export duty of twenty per cent upon all works of antique art, which can henceforth only be removed from the country by declaring their value, paying the duty, and going through the usual vexatious custom-house formalities. Moreover, to avoid undervaluation of a class of objects which have no definite market price, the Italian Government expressly reserves the right to appropriate on the spot any article of the kind which it finds in possession of a traveller or dealer, on paying him the sum which he mentions in his declaration as the cost. Although this new law is likely to bring in a considerable sum to the Italian Treasury, it is sure to be felt as an intolerable annoyance to travellers, who will have to submit to long searches, and may very possibly be required to pay duty on objects purchased outside of Italy, and simply brought through the country, since it would be virtually impracticable to distinguish between coins or bronzes bought in Venice and those which came from Trieste or Munich. We cannot say that we are extremely sorry to have American tourists, who allowed their representatives to vote for their own law without energetic protest, made to realize how much trouble may be caused by ill-considered statutes, without any corresponding good to any one, but it is a misfortune for every one outside of Italy, except, perhaps, the Swiss and English manufacturers of sham antiques, that a check should be put upon the distribution of the unrivalled works of antiquity among those who have education enough to appreciate them.

M. REMAURY writes to *Le Génie Civil* a letter on the subject of the recent rise in the price of copper, which is interesting, and shows, as often happens in such cases, that the movement might easily have been anticipated if those in a position to know the state of the market had taken the trouble to reflect upon the inevitable consequences of its condition. According to the letter, the production of copper has not greatly varied for several years, the total for the world having been two hundred and twenty thousand tons in 1884, two hundred and twenty-six thousand in 1885, and two hundred and sixteen thousand in 1886. The price, however, has changed greatly. To say nothing of the enormous prices of ten years ago, the average market-value of copper in 1884 was about twenty-two per cent, and in 1885 about six per cent higher than in 1886. Even in 1884, the low price of the metal had been severely felt at the mines, and 1885 found several of the smaller ones closed, on account of unsatisfactory conditions of the market, while the owners of the others were complaining loudly of their condition. The effect of this was shown in the diminished production of 1886, yet, although a loss of five per cent in the output of an article, the consumption of which is usually so closely adapted to the supply, was obviously a serious matter for consumers, the price continued to fall during 1886. This set up an abnormal condition of the market. With such a desirable material as copper, any fall in price leads to an increase of consumption, since every one is ready to substitute copper for iron as soon as it is economical to do so, and in 1886 the price was falling, the consumption increasing, and the production materially diminishing. It could only be a question of a few months when the reaction would occur, and the demand again be equalized with the supply by an advance in price, yet so slow were dealers to perceive this that during 1887 the stock of copper on hand, through the excess of demand over the supply, fell at the rate of fifteen hundred tons a month, until, on the fifteenth of last December, the total stock of Chilian and Australian copper in England and France fell to forty-four thousand tons, or less than four months' supply. At this very moment the fire occurred in the Calumet and Hecla mine, burning out the galleries, and effectually closing for a year, at least, as the best judges considered, a source from which came thirty thousand tons a year, or about one-seventh of the whole production of the world; and the now famous French syndicate thought that the time had arrived for a turn in the market. One of the principal members of the syndicate was the Société Industrielle et Commerciale des Métaux, which consumes regularly in its own factories twenty-five thousand tons of copper a year, and would thus be quite justified in buying a year's supply for its own purposes, without regard to any profits to be made by selling again; but it was not unnatural, in view of the situation of the market, to do more than this, and secure the whole stock in Europe, advancing the price afterward, as the syndicate has done, to exactly double the market rate of December, 1886. Of course, the rise in value will set at work the smaller mines and the supply will again increase, but meanwhile the syndicate will have pocketed its profits as the reward of an intelligent study of the conditions of the business for a suitable period.

THE *Scientific American* mentions something which is worth remembering by those who have iron roofs or floors to take care of, and which it finds in an article in the *Engineer*, describing the precautions taken to protect iron and steel ships. According to the *Engineer*, the corrosive action which takes place in metal ships, and which forms the principal source of their deterioration, cannot be entirely arrested by any practical process. Painting, either with lead or iron pigments or the black paraffine varnish, is found to be of little, if any use, the rust going on under the paint quite as fast as on an unprotected surface, especially on the inner surface of the hull, where the wash of the bilge-water, the rolling of lumps of coal and other hard objects, and the careless stowing of the cargo, scratch or detach the coating in places, and set up centres of oxidation. In fact, the covering of paint seems to hasten corrosion, and it is found that the portions of iron decks around the hatchways, where the paint is immediately worn off, lose less by rust than the undisturbed portions near the bulwarks, as is easily shown by the greater thickness, after years of use, of the plates around the hatches. At one time asphalt was much used to protect the inner surfaces of the ship, but at certain

times, and in certain portions of the vessel, the temperature is high enough to soften the asphalt, which runs to the lowest points, leaving the others bare. Then Portland cement was employed, plastered on the iron in layers from one to six inches thick, and often mixed with broken bricks or tiles, or some similar "aggregate," in the thicker portions. This was, and still is, an excellent practice, but in modern ships every inch is of importance, and Portland cement concrete, unless put on in a tolerably thick layer, is apt to scale off, although it is often used simply as a wash. A still better application, however, is found in a combination of Portland cement and pine tar. The surfaces to be treated must be dry and clean and free from rust. The tar is then put on in a good coat and sprinkled with dry Portland cement in fine powder until as much has been put on as will adhere. The cement absorbs the tar and slowly sets, forming a hard and waterproof skin. It seems not unlikely that the same treatment might with advantage be applied to iron roofs. An ordinary corrugated iron roof is a very short-lived affair, and painting does not greatly improve it, but a tar and cement coating, which in most cases need only be applied outside, since the inside would usually be dry, would not be expensive, and ought to be far more effective than paint.

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ACCORDING to the *Builder*, the Municipal Council of Rome has recently passed an ordinance which is likely to be of some indirect benefit to architects. For some years it has been the rule that applications for permits to build in Rome must contain the name of some architect who should be held responsible for the proper planning and construction of the work. The Building Law of New York contains the same requirement, and it was found in Rome, just as it is in New York, that the "architect" named in the application for a permit is in many cases a mere figure-head, being very often a clerk or an ingenious journeyman in the employ of a builder, who is sometimes glad of the opportunity which the law gives him for shifting on the shoulders of such irresponsible persons the liability which ought properly to rest upon himself. With a view to the prevention of this abuse, which may easily have serious consequences, the Roman city government issued a notice that, with a view to the protection of the public, it will henceforth accept as architects in connection with building permits only those persons whose names shall have been registered by a Commission appointed for the purpose as being qualified for the practice of the profession of architecture. Of course, all the persons who wished to practice this profession in Rome immediately applied to the Commission for registration, and, according to its report, one hundred and twenty-five, out of one hundred and sixty-six candidates, were accepted as possessing the necessary qualifications. These, according to the *Builder*, comprise a diploma in physics and mathematics from the University of Rome or that of Bologna, besides a certificate of three years' attendance at a technical school, and a course of instruction in a school of art, so that the standard of theoretical training among the Italian architects would appear to be very high.

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A GOOD deal is said just now about a new light, the so-called "lucigen," which has been brought into use in several of the English railway stations, and has proved very successful and very cheap. The principle of it is simple enough, oil of creosote, a cheap coal-tar product, being blown in spray into the lamp by a jet of compressed air, and allowed to burn in the jet of air; but the effect is remarkable. Naturally, it is most economical to employ it on a large scale, a powerful jet, carrying a considerable amount of spray, requiring little more power or machinery than a small one, so that it is employed for lighting railway-stations in large lamps, each having an illuminating power of three thousand candles. This is about equivalent to six ordinary electric-arc lights, but the lucigen has the advantage over the arc light that its flame is much larger. While a lucigen lamp throws out six times as much light as a common arc-light, it presents a luminous surface three hundred and fifty times greater, and this is found to assist very much in that diffusion of the light which is so necessary to good artificial illumination, and which is so difficult to obtain with arc-lights.

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THE Parisians, who, as we all know, are very old-fashioned in their notions, have just finished a splendid building and now desire to have it decorated. Acting in accordance with that slavish subjection to tradition which characterizes, we will not say the subjects of monarchies, but the effete inhabitants of the old world, they have not been able to think of any better way of having this done than by getting the best decorators to do it, and the only question which has occurred to their paralyzed intellects was that of determining who the best decorators might be. With this idea they, or their representatives, the Municipal Council, have appointed a commission of experts, comprising twelve members of the Council, four architects, three sculptors, and several critics, which, under the presidency of the Prefect of the Seine, is to make choice of the artists most worthy to embellish the town-hall of the great city. Obviously, such a commission, if the opinions of its members were worth anything, would hardly be unanimous in its choice, and a certain amount of balloting has been necessary to fix upon certain names, but it seems to be agreed now to recommend the employment of Cabanel for the painting of the ceiling of the Salle des Cariatides, of Puvis de Chavannes and Roll for the decoration of the vestibules leading from this room to the Salle des Fêtes, of Delauney for the grand staircase, of Bonnat, Jules Lefebvre and Besnard for the three reception-rooms facing the Seine, and of Jean-Paul Laurens for the historical pictures which are to adorn the adjoining corner room. All these artists rank among the very best in France, but, in order to give room for the discovery of some genius hitherto unknown, one apartment, called the Prefect's Parlor, which presents a peculiarly favorable opportunity for mural painting, is to be reserved for an artist to be selected in public competition. The scheme, as formed by the Commission, must be sanctioned by the Municipal Council, but there can be little doubt that it will be adopted.

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IT will be observed that this plan, although it will make of the Hôtel de Ville the treasury of the masterpieces of the greatest artists of France, has not the merit of great novelty, since most large public buildings in Paris are made interesting in much the same way, but we wish to insist on the fact that such antiquated proceedings are not to be taken as models for the conduct of similar affairs in this free and enlightened country. To use the words of an enthusiastic politician, it is just a hundred years since, by a desperate struggle, we cut loose from all bondage to Old-World ideas, and we must beware of the tempter who would now try to persuade us to return to them. Instead of this laborious way of choosing the persons who are to furnish the objects of art for which the public treasury pays so liberally, the practice consorting most with our unsurpassed institutions appears to be for those who have the care of our public affairs to speak habitually with scorn and contempt of artists and art, to refuse to recognize them as understanding anything about their own business, and to pay no attention to their almost unanimous petitions, but as soon as an attractive widow with a talent for painting, or a pretty girl with long curls and a gift of sculpture, comes along, or a "good feller" of a wandering Italian fresco-painter drifts to Washington, to set them at work disgracing the public buildings with their ridiculous devices at a rate of remuneration which would seem fabulous to a Baudry or Puvis de Chavannes, but which here is said to yield only a moderate income, on account of the enormous percentages levied upon it by the lobbyists and go-betweens who claim to have had a hand in procuring the necessary appropriations. We should be sorry to interfere with the affairs of the well-meaning persons who have hitherto furnished the public art, and it is something to be proud of that not the slightest breath of scandal has ever sullied their relations with the Government, but not even innocent enthusiasm on one side and indulgent prodigality on the other can excuse such freaks as the abandonment of the Rotunda of the Capitol, the central point, as we may say, of the whole United States of America, to the manipulations of a man who can think of nothing better to decorate it with than a band of little figures with big heads and shaky knees, executed in stone color, with painted shadows, to imitate a sculptured bas-relief. We have very little patience with the people who praise everything bad which happens to be American and decry everything good which has been invented abroad, but we have still less with those persons in authority who, in a country which can furnish a St. Gaudens, a Warner or a LaFarge, to say nothing of many others, deliberately turn their backs upon their own fellow-citizens, who, without public aid or countenance of any kind, have raised their country very nearly to the highest rank in the world of art, and call in a foreigner to display the cheap accomplishments of an Italian village whitewasher upon the walls of the principal public room of the principal building of the nation.

## BUILDING ACCIDENTS.[1] — V.

THE "One-horse Shay" claims to be a triumph of logic, but to the writer it appears a triumph of engineering in which the clearly framed specifications were faithfully carried into execution. The statement of the deacon:

"One thing is plain,
The weakest part must stan' the strain,"

must certainly be admitted as one of the soundest of engineering opinions.

Although there is so much repetition in the methods of construction and load imposed that a mere regard for precedent would, in most cases, insure the safety of buildings, yet there are numerous instances of failure which are never known to the general public, because those responsible for the matter are naturally averse to any publicity, and generally succeed in avoiding it, unless loss of life or serious personal injuries gives rise to judicial investigation.

It must be an easy task for the brilliant sceptic to lecture upon the mistakes of Moses, because his framework is clearly a matter of record; but the mistakes of the Jack-builders and the rascality of the Buddensieks are kept in a corner as far as the circumstances will admit. A citizen of Pittsfield, Mass., recently deceased, well-known as the largest real-estate owner in the place, and equally well-known on account of his aversion to extravagance, was severely injured by the falling of a staging on one of his buildings. After his return to consciousness, some one by way of consolation told him that two of the men were hurt a great deal worse. "Well," he said, "I think that if we had braced it with just one more lath and two nails, all these suits for damages would have been avoided."

Thoughtless acts on the part of workmen sometimes lead to disastrous results. A well-known instance of a falling mill has been ascribed to fastening a block and tackle to a column, and pulling it out of position while moving some heavy machinery. A few years ago, one of the roof-trusses fell into the hall in Marblehead, Mass., because a piper had cut one of the members nearly in twain, rather than make an offset in his pipe.

There are two classes of accidents to buildings; first, those occasioned by faulty construction; and, secondly, those arising on account of the depreciation of the building or changing of the purposes for which it was originally constructed.

Most of the elements of weakness in buildings are disclosed during construction, because at those times the structure is apt to be subjected to more severe and concentrated loads than will occur after it is finished. It is not unusual to see lumber piled up in building so as to impose a load of two or three hundred pounds to the square foot upon floors which will not afterward be required to sustain a load of over thirty pounds to the square foot. When machinery is being installed in mills, it is generally pressed up together so as to occupy as little floor-room as possible, although by so doing the load per square foot may amount to three times as much as it will when the machines are in position.

Another important circumstance which prevents building accidents from reaching disastrous results, is the warning which timber gives of undue strain, so that breaking can be averted by timely repairs. A number of years ago, Rev. Lorenzo Dow, the celebrated and eccentric itinerant preacher, was announced to officiate in a church in Charlestown. While sitting in the pulpit he noticed that the side-galleries of the church showed that they were overloaded, and rising, he said to the congregation, "There will be no services in this house this evening." A murmur of indignation arose, and in giving vent to it over what they supposed to be merely one of the inexplicable eccentricities of the man, the church was emptied very slowly and without shock to the overloaded galleries. But before the church was entirely empty he announced that he would lead the services from the church steps. A similar forethought might have averted the casualties resulting from the fall of an iron-pillar in the Church of the Immaculate Conception on Fourteenth Street, New York, during a crowded morning service on the eleventh of December. A similar story of the presence of mind of a speaker, in slowly relieving the load in a dangerously crowded building, is attributed to General B. F. Butler, who adjourned a crowded political meeting from a hall to the public square.

Two years ago during an excursion of one of the national engineering societies, while holding their meeting in Boston, they visited an establishment for the purpose of listening to the exposition of important engineering matters by their designer. The members did not enter the room in the order of their going, but their president brought up the rear, who noticing that the beams and joists of the floor above were showing unusual flexure by reason of the excessive load imposed upon it by the crowd, summoned the help of a number of workmen, and the floor above was shored up as the weak places were disclosed, and in this manner without alarming or even informing any of the crowd above, a most deplorable accident was undoubtedly averted by the energy and presence of mind of one person.

Accidents to buildings are, in many cases, primarily due to faulty foundations. Walls are placed on inclined ledges, in some instances even those overlaid with clay, without cutting steps in the ledge in order to remove any horizontal component due to the load of the structure. At the present time I have knowledge of a building resting on an inclined bed of clay which has already moved about six inches in a horizontal direction, and although only one story in height it is fissured with cracks, and only held together by means of numerous and unsightly tie-rods. Such accidents are frequent in buildings placed on the banks of rivers.

Under certain conditions, buildings have been injured by reason of too broad foundations; that is, when placed upon compressible earth, portions would settle unequally. A very high mill which was recently taken down in Eastern Massachusetts to make way for one of modern construction and corresponding facilities for manufacturing has settled under the walls about three inches more than under the columns, making the floors more like a ship's deck than is usually found on land. Such injury may be obviated by the use of the system of independent foundations which are so arranged as to impose a uniform load per square foot upon the earth. Some of the buildings in Chicago have been erected upon such foundations receiving a uniform load of about two tons to the square foot, and the settlement of such structures is uniform and without injury to the building, while it is well known that many buildings in that city have been very seriously injured by unequal settlement.

Another difficulty in foundations, especially those under mill buildings, has been due to springs or to water oozing from the canal furnishing the water-power and percolating under the walls.

Other injuries have owed their origin to the decay of piles which were cut off at a grade above that of the water-stratum in the earth, and there have also been difficulties arising from the transverse yielding of the piles in the soft-earth of the Back Bay, Boston, which was caused by the horizontal stress from the roadway; although these mishaps have been infrequent except in the case of the approaches to the highway bridges in that portion of the city.

The knowledge of resistance of materials is undoubtedly more complete in regard to transverse-stress than any other element of applied mechanics. The simplicity of the general problems is such that the precedents which form the basis of all formulas are easily assimilated in the mind of observing persons, even though they cannot integrate their own mental actions; and the intuitively correct judgments of persons of practical experience yet without any knowledge of mechanical principles in regard to the question of safety of a structure under transverse loads, is a matter of frequent course; but, when any complication is introduced in a design, the mind of such a person is rarely trustworthy from inability to conform to new conditions. A complete formula is nothing but organized experience, and it requires more skill to apply a formula than to deduce it. One of the leading engineers in this country once declared that the art of machine-design consisted in the free use of pig-iron; and in this connection it may be truly said that a good designer must be a good copyist.

A frequent error in floor-design is caused by the endeavor to obtain an economical distribution of material by increasing the depth of the beams and diminishing the width, so that the intensity of pressure at the points of support exceeds what should be permitted for conditions of safety, and such beams sometimes shear off near the points of support rather than break by bending. The resistance of wood to transverse-pressures is about one-third that of compression in the line of the grain, and it is

[1] Continued from page 134, No. 612.

noticeable that the transverse contraction by seasoning amounts to three-eighths of an inch or more per foot. A due consideration of these facts should prevent any one in the design of a mill-structure from placing wooden bolsters over the columns, and transmitting the load from one column through the bolsters and beam to the column below; but rather let each column be surmounted by a cap of at least three times the area of the cross-section of the column, and above this an iron-pintle should run to the plate forming the base of the column above. In this manner the whole resistance of the column can be utilized and the building saved from being thrown out of line with the attendant deterioration and injury to machinery by the aggregate movement due to the transverse contraction of the beams and pilasters, which reaches an excessive amount in the upper stories of a high building.

Since the days of Samson, it might appear that careful attention would be given to the strength of columns, but it is within the memory of persons too old perhaps to be called young men, but not old enough to call themselves so, to recall a deplorable accident to a mill which fell in a neighboring manufacturing city, with attendant loss of life and serious injury to person and property. It was shown in the course of investigations following that matter, that the columns supporting that mill were hollow iron pillars of unequal thickness on opposite sides, owing to the floating or dislodgment of the cores when founded in a horizontal position. These columns were, moreover, further weakened by a three-inch pintle pressing upon cast-iron plates three-fourths of an inch thick, and six-and-three-fourths inches across the hollow end of the column, which caused the pintles to punch through the ends of the column as soon as the equilibrium of the mill was disturbed. Those desiring to examine into the matter, can see a drawing representing the whole arrangement in the "*Transactions of the American Society of Mechanical Engineering*," Vol. II, page 271.

But these mills were not the only ones loaded to a dangerous extent, or with iron-columns containing shells of unequal thickness: during other investigations I have seen instances where iron-columns safe for twelve tons, using a factor-of-safety of five, have sustained thirty-six tons for nearly thirty years. In another instance, wood-columns whose estimated resistance to crushing was thirty-eight tons, had sustained a load of seventeen-and-one-half tons for fifteen years.

In some repairs upon a mill, the excessive deflection of a large cast-iron beam was noticed, and the careful computation of the load upon it and also its resistance to breaking showed that the beam had sustained eighty-five per cent of its estimated breaking-weight for forty years.

These instances are given not as precedents to justify small factors-of-safety, but merely to illustrate what dangerous elements of construction are comparatively frequent, and yet by reason of other matters of unusual stability by way of foundations or walls, the stress upon these members has been so uniform and free from transverse or other disturbances that the logical result of such continued loads has not occurred.

It should be carefully arranged in the design of storehouses that the height of each story should not be sufficient to allow an excessive weight of goods to be placed in each room.

A building connected with a woollen mill, built for the purpose of holding empty goods cases, was afterward used for storage of compressed bales of rags for shoddy, loading the floor so that the modulus of rupture upon the spruce-beams amounted to three thousand and two hundred pounds, or twice that which a due consideration for safety would have allowed.

A large amount of terra-alba was stored in a building of a paper-mill designed for the bins of paper trimmings, and before morning the clay had passed into the cellar by the most direct route. Experiments upon full-sized wooden columns at the Watertown Arsenal show as a result that Southern pine columns would sustain, on the average, four thousand and four hundred and fifty pounds to the square inch, while it is known that the general allowance of load upon such columns is six hundred pounds to the square inch, and that they sustain this load without depreciation or sign of weakening.

The most frequent cause of depreciation of buildings arises from dry-rot of timbers, which can generally be avoided by allowing the air to have free contact with the timber, and the application of whitewash or plaster on wire-lath seems to preserve timber as well as protect it against fire. There have been some instances where the plaster has been covered with stucco for decorative purposes, completely sealing the timber against the air, and this in turn has been followed by dry-rot

The use of tinned-coverings upon large timbers and doors for the purpose of defense against fire, is apt to cause dry-rot when the lumber is imperfectly seasoned; and, as such tinned fire-doors have served their purpose better than any other type of fire-doors, it is important that they should be constructed of well-seasoned stock.

A similar cause of dry-rot results from attempts at decoration by varnishing partially seasoned timber which completely seals it up, and furnishes the most perfect expedient that can be adopted to accomplish this end. It requires at least six years after the building is finished, to season Southern pine timbers one foot in width.

Beams are frequently sealed so tightly where they enter the wall that dry-rot takes place within the walls, while the exposed portion of the beam within the room is entirely sound.

A large mill was built a number of years ago, just previous to the failure of the corporation, and lay unoccupied for about five years. When the property was sold, the new owners did not dare to place machinery in this mill until the beams had been removed and new ones substituted. The portion of the beams in the rooms was entirely sound, the decay being limited to the portion built into the walls.

The general method of construction to obviate the difficulty is by building pilastered walls containing vertical flues into which the end of the beams project, while at the side of the beams and on top, a slight air-space is left during construction.

Dry-rot frequently occurs in the beams of the first story of a mill without any cellar, and it has been obviated in the most successful manner in cotton-mills by running a flue from the picker-room to this space under the mill, and making a number of six-inch holes through the underpinning walls of the mill; the pickers requiring a supply of air draw it from outdoors beneath the mill, and in that manner dampness is prevented from gathering upon the beams.

It is proverbially well-known that wood will withstand decay when kept either entirely wet or absolutely dry. The piles that supported the houses of the pre-historic dwellers over the Swiss lakes, and the wood in the tombs of Egypt, both attest the accuracy of this statement. But in a more familiar way it may be noticed in the beams used in wet places around water-wheels where timber pressed against a wet ledge will decay towards the wheel where it is exposed to dampness, and remain perfectly sound at the end which is constantly wet.

Much has been said and little done about the antiseptic treatment of timber. The most valuable contribution to the subject being contained in the "*Transactions of the American Society of Civil Engineers*," Vol. IV, page 274, but the difficulty with all preparations has been their solubility in water or their expense. Lime seems to be the most perfect preservative for wood as long as it can be kept in contact with it. Exposure to water which will remove the lime, will, of course, leave the wood defenceless, although one may notice in the old-style paper-mills operated by overshot wheels, that the portion of the wheel receiving the lime refuse thrown out from the bleaches will remain sound, while the rest of the wheel will decay with a rapidity dependent upon the character of the water in the stream and the lumber employed. The general value of lime as a preservative of wood, may be noted when one considers the admirable condition in which laths are always found. I doubt if any one ever knew a decayed lath to be removed from contact with plaster.

The use of modern types of rolled-iron beams has been followed by the most satisfactory results in the matter of safety; a result no doubt largely due to the skilled supervision which such work has received, but in a great measure it is ascribable to the excellent tables and information of the most reliable nature contained in the catalogues issued by the rolling-mills, which are prepared by the best engineering skill, and are far more trustworthy than pretentious treatises upon the subject.

It should be stated that the foregoing notes are offered entirely from the standpoint of an engineer, and not from that of an architect who is obliged to consider these various problems in combination with elements of design, and also with questions of convenience which are rarely in harmony with the best conditions of applying engineering principles and economical distribution of material.

Like all other works of mankind, those of the architect do not reach an idealism, but their defects are generally the result of obstructive conditions limiting every element of the work, and far from what would be done in accordance with the untrammelled judgment.

As Carlyle said of Voltaire, "You, indeed, swing the torch to burn old abuses, but where do you wield the hammer to build new reforms."

It is, indeed, more easy to offer a criticism than to apply any practicable suggestions with prospect of prevailing; knowing that the accomplishment of sounder methods of buildings can be established only as public sentiment is developed to require such courses as will attain greater measures of stability, permanence and beauty.

C. J. H. WOODBURY.

[To be continued.]

## OPEN-TIMBER ROOFS OF THE MIDDLE AGES.[1]—III.

### (*B* 3) *Collar-braced Roofs.*

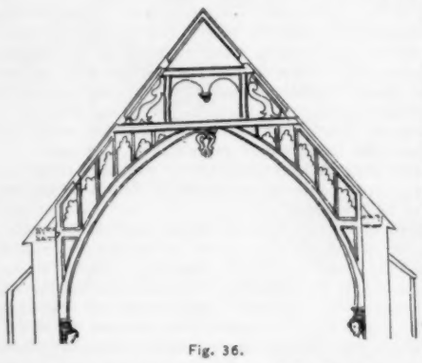


Fig. 36.

THE collar-braced roof is properly considered as a simplification of the hammer-beam. It had been found, as is shown in the different varieties of hammer-beam roofs (33, 34, 35) that the different members, as collar-beam, braces, etc., could be separately dispensed with. In the Westminster example it was evident that the ability of the hammer-beam for so large a span had been questioned and assistance was sought and obtained in the form of the large arch. As a matter of fact, the arch does nearly all the work, as may be seen from the method of framing. The next step in the order of development, therefore, was to discard the hammer-beam itself (Fig. 36) and emphasize other members, viz., the collar-beam and braces, whence the name collar-braced roof. The forms of trusses used in this kind of roof often resemble those used in the trussed-rafter roof, but it must be remembered that the former is double-framed, whereas the latter is a single-framed roof. This distinction must be kept in mind, for the term collar-braced roof is made to include roofs in which the braces are very flat and the collar-beam is reduced to a mere wedge at the ridge. (See Figure 37.)

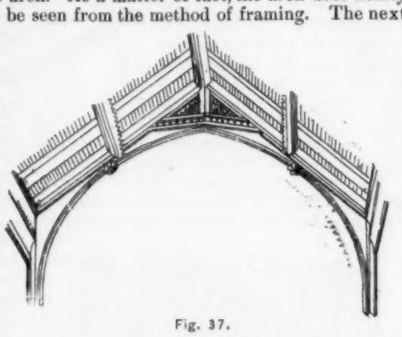


Fig. 37.

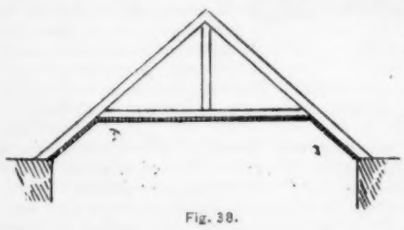


Fig. 38.

Collar-braced roofs, with flat Tudor arches, were used in the late Perpendicular period, but were, of course, limited to small spans.

### ROOFS AS THEY OCCUR IN THE HISTORICAL STYLES.

*Norman.* — The wooden roofs of the period are of the simplest type. Generally the tie-beams are placed close together, and to their undersides a flat wooden ceiling is nailed. Often, however, the roofs are not sheathed, but in such instances there is little effort toward decorative treatment. The roofs of Rochester and Winchester are cited by Rickman as examples of Norman open-timber roofs, while that at Peterborough is typical of the flat-boarded ceiling class. At Peterborough the tie-beam is raised so as to give a form like that in Figure 39. The ceiling is painted with a geometrical design, in which appear zigzag lozenges and other characteristic Norman ornament. The roof at Ely is treated in a similar style, but the roof takes a pentagonal shape somewhat as shown in Figure 39.

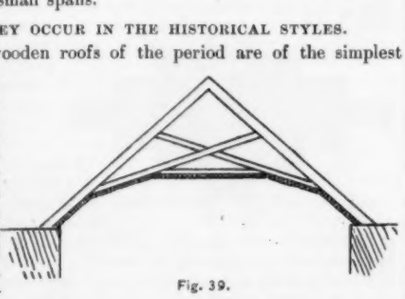


Fig. 39.

*Early English.* — Very few examples exist of roofs which can be clearly distinguished as belonging to this style. The trussed-rafter roof is generally supposed to have come into use during this period. The decorative treatment is rather plain. The timbers are usually chamfered; the tie-beam is sometimes moulded. Wooden ceilings in imitation of stone-vaults are found, the details of which are Early English in character. An example of such a wooden roof was shown in Figure 2. The cloisters of Lincoln were roofed in this fashion. The pitch of the roofs in this period was steep and did not vary much, the angle at the ridge generally approximating a right angle.

*Decorated.* — The construction of roofs in this period does not differ materially from that of the preceding except in the more careful elaboration and greater richness of details. A form of frequent occurrence is the trussed-rafter with arched ribs. Interrupted mouldings are terminated with carved leaves, etc. Spandrels where they occur are generally pierced and filled with tracery. An interesting roof is that over the Archbishop of Canterbury's palace at Mayfield, Sussex. This roof is really supported by great stone-arches, a device that was adopted in several other places.

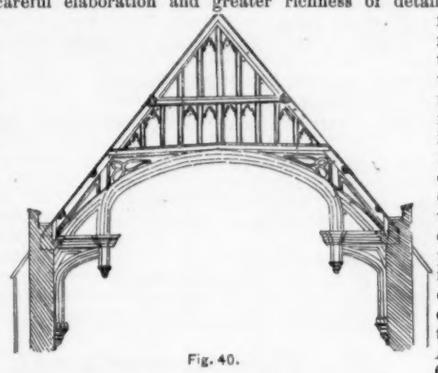


Fig. 40.

*Perpendicular.* — The characteristic roof of this period is the hammer-beam, of which the best known specimens are those at Westminster Hall, Hampton Court, and Eltham Palace. The roof of the hall at Eltham (Figure 40) is not so large nor so well designed as that at Westminster. The large arch is made so flat and the hammer-beam braces are so short and placed so high up that the constructive proportions of the hammer-beam roof were, as Fergusson says, destroyed. In fact the constructive significance of the big arch, so striking in the Westminster example, is neglected in that at Eltham. Nevertheless, "with all its constructive faults there are few examples of more elegance to disarm criticism and invite admiration."[2]

These hall-roofs were very large and elaborate. Those used in churches were much smaller and less pretentious. A good example of a roof of the latter class would be that of Trunch Church (Fergusson, Vol. II, page 183.) In Figure 34 the main lines of the roof may be seen. As has been said, the varieties of the hammer-beam roof are many, no two, in fact, being exactly alike. All, however, are characterized by rich decoration, tracery, mouldings, bosses, angels, etc., are found in great profusion.

Another kind of roof commonly used in churches of small span is the tie-beam roof of very low pitch (Figure 19.) In this roof the purlins and rafters were made by their intersections to form squares or oblongs. These were marked by flowers or shields, or filled with tracery; the effect in general being one of panels so characteristic of this style.

### CONCLUSION.

*Material.* — The timber used in the construction of these roofs was oak. Chestnut is said to have been used to some extent, but the statement cannot be said to have been substantiated.

*Fastenings.* — The invariable method of fastening timbers together was by mortice, tenon and wooden pin. No iron bolts or straps were used. The reason for this is that the corrosion of the iron is followed by decay of timber, and this by loosening of bolts.

*Purlins.* — In almost all the roofs it will be observed that the purlins instead of lying over the principals, as in ancient and modern roofs, are framed into them, thus making the common rafters flush with the principals on their upper surfaces.

*Ridge.* — One peculiarity to be noticed in the framing of the rafters is the absence of the ridge piece, the rafters being simply halved and fastened by an oak pin. Even where the ridge piece is found the rafters are framed as before, and the ridge timber appears beneath them.

"There can be no doubt that in many cases the Gothic carpenters relied too much on the sizes of timbers and the strength of timber used, rather than on strictly scientific construction."[3] This is undoubtedly true, but it is to be said on the other hand, that one great beauty of many of these designs is that they show that due allowance has been made not only for sufficient strength for actual construction but also for the appearance of strength, an effect that is always satisfactory.

[1] Continued from No. 631, page 41.

[2] From an article on "*British Carpentry*," *Building News*, 1870.

[3] From an article on "Roof Construction of the Middle Ages," *Building News*, 880.

*Decoration.*—Many of the roofs were decorated both by color and relief. Red, green, yellow and gold were the colors most frequently used. The carving is always excellent.

"So essential does the vault appear to have been to Gothic architecture . . . that it is at first sight difficult to admit that any other form of covering can be as beautiful. But some of the roofs in English churches go far to refute the idea. Even, however, if they are not in themselves so monumental and so grand, they had at least this advantage, that the absence of the vault allowed the architect to play with the construction of the substructure. Great merit of the wooden roof was that it enabled the architect to dispense with all flying-buttresses, exaggerated pinnacles and mechanical expedients, which were necessary to support a vault, but which often sadly hampered and crowded his designs." [*Fergusson.*]

APPENDIX.

A list is subjoined of the authorities, consulted in the preparation of this paper.

Brandon. "*Open Timber Roofs.*"
*Builder*, 1876. Article on the "Architectural Treatment of the Roof."
*Building News*, 1870. Articles on "British Carpentry."
*Building News*, 1876. Articles on "Woodwork."
*Building News*, 1880. Articles on the "Roof Construction of the Middle Ages."
Davies. "*Architectural Studies in France.*"
Fergusson. "*History of Architecture.*"
Hubsch. *Monuments de L' Architecture Chrétienne.*"
Johnson. "*Specimens of Early French Architecture.*"
Parker. "*Glossary.*"
Rickman. "*English Architectural Styles.*"
Smith. "*Specimens of Ancient (British) Carpentry.*"
Tredgold. "*Elementary Principles of Carpentry.*"
Viollet-le-Duc. "*Dictionnaire Raisonné de L' Architecture*" (Charpente.)

Harry Ellingwood Donnell.

## THE ILLUSTRATIONS

[*Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.*]

CHURCH OF ST. PIERRE, MONTREAL, P. Q.

[Gelatine Print, issued only with the Imperial Edition.]

For some mention of this building, see the *American Architect* for October 1, 1887.

HOUSE FOR P. E. CHILLMAN, ESQ., CHESTNUT HILL, PHILADELPHIA, PA. MR. J. C. WORTHINGTON, ARCHITECT, PHILADELPHIA, PA.

Material, Chestnut Hill stone throughout; roofs throughout, cedar, shingle stained with Cabot's Creosote Stain; woodwork painted in neutral colors; gable ends, dashed plasterwork; interior finish, white pine, natural finish; hall in oak. Building about 40′ x 50′. Cost approximates $8,000. The special feature of the house is in arrangement of bath and water-closet rooms, which may be made common or separate at will.

HOUSE OF A. O. LANE, ESQ., BIRMINGHAM, ALA. MR. EDOUARD SIDEL, ARCHITECT, BIRMINGHAM, ALA.

This house is now in course of construction and is situated on the corner of 8th Avenue and 19th Street. It is built of stone, cast-iron, St. Louis pressed brick, and has a slate roof; contains all the modern improvements in the way of heating, ventilation, and electric bells, etc. It will cost when completed $30,000.

COMPETITIVE DESIGN FOR THE NEW YORK LIFE INSURANCE BUILDING, ST. PAUL, MINN. MR. J. WALTER STEVENS, ARCHITECT, ST. PAUL, MINN.

HOUSES FOR E. W. COOPER, UTICA, AND FOR PROF. H. C. J. BRANDT, CLINTON, N. Y. MR. EDWARD W. COOPER, ARCHITECT, UTICA, N. Y.

STREET IN ST. LIZIER, ARIÉGE, FRANCE. SKETCHED BY MR. H. P. KIRBY, ARCHITECT.

The Death of M. Godin of Guise.—The founder of the "Familistère" at Guise, Aisne, has just died. St. Jean Baptiste André Godin was the son of a locksmith, and was born in 1817. In 1846 he set up as an iron-founder at Guise, and speedily became wealthy. In 1859 he erected the "Familistère," consisting of 600 cottages, with co-operative shops, club, theatre, etc., for his workmen. In 1871 he was elected a Deputy, but withdrew from public life in 1875.—*London Times.*

## FOURTH ANNUAL REPORT OF THE BUREAU OF ETHNOLOGY.[1]—III.

FRANK HAMILTON CUSHING ON PUEBLO POTTERY AND ZUNI CULTURE GROWTH.

Fig. 510.

The paper by Mr. Frank Hamilton Cushing on "A Study of Pueblo Pottery as Illustrative of Zuñi Culture Growth" is made, by the method adopted, a most important and remarkable contribution to ethnological research. It appropriately follows the papers by Mr. Holmes, for, in pursuing a different line of investigation, Mr. Cushing affords absolute confirmation of the correctness of Mr. Holmes's conclusions, arrived at wholly from an archæological standpoint. Mr. Cushing combines his archæological knowledge with a close intimacy with the Zuñi tongue, obtained by his long course of ethnological researches among that people. Working largely on linguistic lines, in a way that shows the born philologist, with rare ingenuity he weaves from the inherent evidences of language a network of evidence that runs far into the forgotten past, and from vanished ages he brings facts concerning the origin of an art into the light of this century's knowledge.

Through the kindness of the Bureau of Ethnology, the *American Architect* was enabled a few months ago to lay before its readers, from advance sheets, the first part of Mr. Cushing's paper relating to "Habitations affected by Environment." It formed a unique contribution to the literature of "American architecture" in the purest sense, and therefore it was with peculiar appropriateness that it first saw the light in this journal. Many of our readers must have been impressed with the strength of the evidence afforded by the linguistic argument whereby was indicated the probable sequence of architectural types in the evolution of the Pueblo, from the brush lodge, of which only the name survives among the Zuñis of today, to the present many-storied and terraced communal structures to be found throughout New Mexico, Arizona and contiguous regions.

Fig. 511.

The linguistic evidence of the derivation of Zuñi pottery from basketry, as cited by Mr. Cushing, affords a complete chain of proof. He describes the lining of a shallow tray of basket-work with clay to make it available for roasting purposes or processes, which he has witnessed among the Havasupai Indians, a sedentary tribe isolated in the Colorado Cañon. This clay lining, hardened by continual heating from the coals placed upon it, when detached from its matrix of osiers, forms in itself a complete roasting-vessel. The modern Zuñi name for a parching-pan; a shallow bowl of black-ware, has a name of the same meaning as that applied to a basket tray, signifying "a shallow vessel of twigs."

Fig. 512.

Anciently, boiling was done, with the aid of hot stones, in water-tight baskets of pot-like shapes. These and kindred forms of basket-vessels were often quite elaborately ornamented by angular devices, like serrated bands, diagonal or zig-zag lines, chevrons, and even terraces and frets. Mr. Cushing traces the development of these methods of decoration to the elaboration on suggestions of the lines and figures unavoidably produced in wicker-work of any kind when strands of different colors happen to be employed together and even by slight discolorations in occasional splints. The probability of this view is shown by a consideration of the etymology of a few Zuñi decorative terms. A terraced lozenge on their pottery, instead of being named after the abstract word that signifies a double terrace, or two terraces joined at the base, as would naturally seem to be what they would do, is called by a word signifying "the double-splint-stitch-form mark," a term clearly derived from basket-work, as may be seen from a comparison of Figures 510 and 511 with 512 and 513. Also, a pattern composed of a series of diagonal or oblique parallel

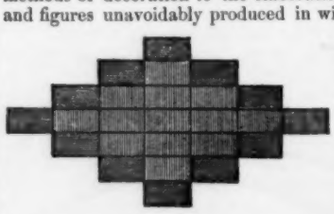


Fig. 513.

[1] Continued from No. 631, page 45.

lines, as in Figure 514, is called a name meaning "tapering" or "neck-splint mark." "Curiously enough, in a bottle-shaped basket, as it approaches completion, the splints of the tapering part or neck all lean spirally side by side of one another (see Fig. 514), and a term descriptive of this has come to be applied to lines resembling it, instead of a derivative from *ás sĕl lai e*, signifying an oblique or leaning line. Where splints variously arranged, or stitches, have given names to decoration — applied even to painted or embroidered designs — it is not difficult for us to see that these same combinations, at first unintentional, must have suggested the forms to which they give names as decorations."

Fig. 514.

It seems that the method of forming basket-work by a coiling process suggested the method of making pottery by coiling it of thin ropes of clay. The evolution of the cooking-vessels of modern Zuñi from the coiled boiling-basket of ancient times is indicated by the close resemblance of form between the vessels of pottery and of basket-work, with even the rudimentary survival of the basket-handles in two conical projections near the rim of the clay pot, varied in later times to form scrolls. A most convincing link in this chain of connection, however, is to be found in the names of the two kinds of vessels, the name of one meaning "coiled cooking-basket" and the latter "coiled earthenware cooking-basket." Mr. Cushing shows how other important types of vessels of pottery developed in a similar way from basketry forms.

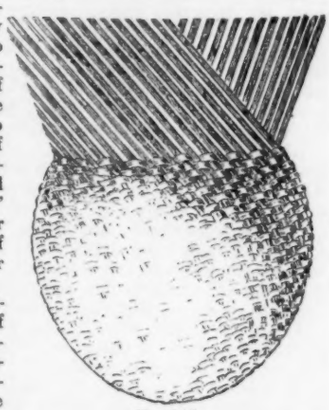


Fig. 515.

An important fact in influencing the development of the ceramic art of the Southwest is shown by Mr. Cushing to be the mineral character of a locality. "Where clay occurred of a fine, tough texture, easily mined and manipulated, the work in terra-cotta became proportionately more elaborate in variety and finer in quality. There are to be found about the sites of some ancient Pueblos potsherds incredibly abundant and indicating great advance in decorative art, while near others, architecturally similar, even where evidence of ethnic connection is not wanting, only coarse, crudely moulded and painted fragments are discoverable, and these in limited quantity." A modern instance is to be found in the outlying farming Pueblos of Zuñi, at one of which, there being an abundance of clays of several varieties and of color-minerals, the finest pottery of the tribe is made in great quantity, while at another, where clay is scarce and poor in texture, the pottery is of miserable quality and poor shape. The same holds true in regard to decoration; where the mineral deposits furnish a great variety of pigment-material, the decoration of the ceramic remains is "so surprisingly and universally elaborate, beautiful and varied as to lead the observer to regard the people who dwelt there as different from the people who had inhabited towns about the sites of which the sherds show not only meagre skill and less profuse decorative variety, but almost typical dissimilarity." Yet the inhabitants of both sections may be of common derivation and even closely related and contemporaneous.

An important fact brought out in Mr. Cushing's discussion of the materials employed and the methods resorted to in burning pottery, is that bituminous coal, according to tradition, was the most perfect fuel, and where abundant and accessible, was much used. Support is given to this tradition by the traces of little pit-kilns filled with cinders of mineral-coal about many of the ruins in the northwestern portion of the Pueblo region, coupled with the semi-fusion and well-preserved condition of most of the ancient jars found associated with them. Additional confirmation was found by Mr. Cushing by discovering that some excellent counterfeits of ancient pottery, brought him at Moki, were made by the use of bituminous coal. When asked why they did not use it commonly in burning their household pottery, the Indians told him that the pots broke more frequently than when fired with dried sheep-dung in the common way, and that the latter was also less troublesome, requiring only to be dug from the corrals near by and dried to make it ready for use. In this connection, it is of interest to remark that Professor Putnam's explorations in Ohio show that bituminous coal was also used by the mound-builders, although its use was not general, owing to the abundance of wood.

The remarks on the evolution of form and decoration are so suggestive and instructive that their brevity is to be regretted. The discussion of decorative symbolism gives a charming glimpse at Zuñi mythology. Mr. Cushing calls attention to the fact that on every class of food and water vessels, in both ancient and modern Pueblo pottery (with the important exceptions of pitchers and some sacred receptacles), it is a singular and almost constant feature that encircling lines and often even ornamental zones are not joined at the ends, a slight space always breaking the completion of the circle. He asked the Indian women, when he saw them making these little spaces with great care, why they took so much pains to leave them open. They replied that to close them was *dk ta ni*, "fearful!" — that this little space through the line or zone on a vessel was the "exit trail of life or being." Of course they could not tell how it came to be first left open and why regarded as the "exit trail." "But," says Mr. Cushing, "if one studies the mythology of this people and their ways of thinking, then watches them closely, he will, however, get other clews. When a woman has made a vessel, dried, polished and painted it, she will tell you, with an air of relief, that it is a 'Made Being.' Her statement is confirmed as a sort of article of faith, when it is seen that as she places the vessel in the kiln, she also places in and beside it some food. Evidently she vaguely gives something about the vessel a personal existence. The question arises, how did these people come to regard food-receptacles or water-receptacles as possessed of, or accompanied by, conscious existences. I have found that the Zuñi argues actual and essential relationship from similarity in the appearance, function or other attributes of even generically diverse things." This mental bias has both influenced pottery decoration and been itself influenced by it. The noise made by a pot when struck or when simmering on a fire is supposed to be the voice of its associated being. The clang of a pot when it breaks or suddenly cracks in burning is the cry of this being as it escapes or separates from the vessel. The fact that the vase when cracked or fragmentary never resounds as it did when whole is regarded as proof that this being has departed. "This vague existence never cries out violently unprovoked, but it is supposed to acquire the power of doing so by imitation; hence, no one sings, whistles or makes other strange or musical sounds resembling those of earthenware under the circumstances above described during the smoothing, polishing or painting, or other processes of finishing. The being, thus incited, they think, would surely strive to come out, and would break the vessel in so doing. In this we find a partial explanation of the native belief that a pot is accompanied by a conscious existence. The rest of the solution of this problem in belief is involved in the native philosophy and worship of water. Water contains the source of continued life. The vessel holds the water; the source of life *accompanies* the water; hence, its dwelling-place is in the vessel with the water. Finally, the vessel is supposed to contain the treasured source, irrespective of the water — as do wells and springs, or even the places where they have been. If the encircling lines inside of the eating-bowl, *outside* of the water-jar, were closed, there would be no exit trail for this invisible source of life or for its influence or breath."

Two considerations are submitted as to why the source of life, or its influence, must be provided with a trail by which to pass out. The difficulty of smoothly joining an incised line around a still soft clay pot, and the still greater difficulty when the ornamental band is laid on in relief, would naturally cause the savage to leave the ends unjoined. When paint came to be the decorative agent, the lines or bands would be left unjoined in imitation. As set forth in Tylor's "*Early History*," a "myth of observation" like the above would come to be assigned in after ages. But whether this be true or not, Mr. Cushing considers it an insufficient solution of the problem.

The Pueblo, he goes on to say, naturally considers water the prime source of life, or as accompanied by it, for, without the presence of living water, very few things would grow in his desert land. He has therefore come to regard water as the milk of adults, to speak of it as such, and as the all-sufficient nourishment which the earth, in his conception of it as the mother of men, yields. When his race was

Fig. 548.

Fig. 549.

one of cliff and mesa dwellers, the most common vessel appertaining to his daily life was the flat-bellied canteen, or water-carrier, which was suspended by a band across the forehead, so as to hang against the back, thus leaving the hands as well as the feet free for assistance in climbing. Its form (Fig. 547) seems to have been suggested by that of the human mammary gland, or perhaps its peculiar form may have suggested a relationship, as may be seen by a comparison

of Figures 548, 549. Its name in Zuñi is derived from the same source as that of the human mammary gland. A surviving superstition inclines Mr. Cushing to the view that the *me he ton*, as it is called, was originally left open at the apex instead of at the top, but, being found to leak with the aperture so low, this was closed. When a woman has completed the vessel nearly to the apex, by the coiling process, and before she has inserted the nozzle, Figure 549, *b*, she prepares a little wedge of clay, and, as she closes the apex with it, she turns her eyes away. When asked why she does this, she replies that it is "fearful" to look at the vessel while closing it at this point; that if she look at it during this operation she will be liable to become barren, or various other calamities may befall her or those who drink out of the vessel! Mr. Cushing's impression is that, reasoning from analogy, the Zuñi woman supposes that by closing the apex she closes the way for the source of life, and that the woman who closes this way knowingly (that is, in her own sight) voluntarily closes the exit way for the source of life in her own mammæ, etc.

Other types of the canteen, of later origin, not only retained the name-root of this primitive form, but also its attributed functions. The canteens used by hunters, shown in Figure 550, has a name that means "mammaries joined together by a neck." In closing the ends, *c c*, of this curious vessel, the women are as careful to turn the eyes away as in closing the apex of the older form. The resemblance to the end of the mamma not being striking, they place on either side of the nozzle a pair of little conical projections, resembling the teats, and so called. The reason for there being four of these seems to be that this canteen is designed for the use of the hunter, whose proper nourishment is the game he kills; hence, the source of his life, like that of the young of his game, is symbolized in the canteen by the mammaries, not of human beings, but of game-animals. We are brought nearer to an understanding of the question under discussion by a feature in these canteens. When ornamental bands are painted around either end of the neck of one of them, they are interrupted at the little projections. Mr. Cushing has, indeed, observed specimens on which these lines, if placed a little further out, were interrupted at the top opposite the little projections, as shown in the illustration. It would seem that paint, like clay, came by analogy to be regarded as a barrier to the exit of the source of life. "This idea of the source of life once associated with the canteen would readily become connected with the water-jar, which, if not the offspring of the canteen, at least usurped its place in the household economy of these people. From the water-jar, it would pass naturally to drinking-vessels and eating-bowls, explaining the absence of the interrupted lines on the oldest of these and their constant occurrence on recent and modern examples, for the painted lines being left open at the apices, or near the projections on the canteens, they should also be unjoined on other vessels with which the same ideas were associated."

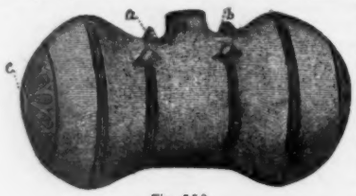


Fig. 550.

This description, which we have necessarily somewhat abbreviated, affords a good example of the subtile methods of research employed by Mr. Cushing, and shows how necessary it is to identify one's self with the life and mode of thought of a people in order to understand them with a correctness essential for true ethnological work. He concludes that we may hope, by a patient study of the ceramic remains of a people, no matter where situated, to discover what was the type of their pre-ceramic vessels, and thereby we might also learn whether, at the time of the origin of the potter's art or during its development, they had, like the Pueblos, been indigenous to the area in which they had been found, or whether they had, like some of the Central Americans (to make a concrete example and judge it by this method), apparently immigrated in part from desert North America, in part from the wilderness of an equatorial region in South America.

There are some things established by the linguistic evidences developed by Mr. Cushing which have a most important bearing on ethnological science. It is shown that the art of pottery-making must have been developed by a people speaking the Zuñi language — from the time of the primitive beginnings of the art founded upon basketry forms — entirely within its own ethnic lines, and apparently unaffected by influences from other peoples. And the long lingual line of descent which has thus preserved the tokens of the ancestry of forms from a past which must be considerably remote, shows a remarkable stability of language. Indeed, it proves how completely erroneous must be the theory advanced, we believe, by Mr. Herbert Spencer, that the languages of primitive or illiterate peoples are unstable. On the contrary, it seems safe to assume as an ethnological law that the language of a people is stable according to the stability of its environment. A language naturally changes to suit changing conditions, and the changes consequent upon a commingling of different peoples, like those entailed by the conquest of England by the Normans, resulting in a new and conglomerate tongue, are, of course, far more swift and radical than those coming from the removal of a people into even an entirely new set of natural surroundings. Investigation would probably show that while the language of a people is made more stable by a general literacy, which fixes and preserves its forms — as shown by the petrifaction of even grave errors of pronunciation and spelling by dictionary authority in the English tongue — the language of an illiterate nation of a high culture grade is made unstable by its subjection to the influences of foreign contact. But a race developing amidst a uniform environment and not subjected to foreign influence, would naturally evince a lingual evolution of a slow and gradual kind, corresponding to the normal growth of the race in thought as modified by experience.

Sylvester Baxter.

## BOOKS AND PAPERS

M. HENRY HAVARD, whose name is ever properly held in regard because of his works on art, has just put forth the first volume of his "*Dictionary of Furniture and Decoration*" [1] from the thirteenth century to our own days. The complete work will consist of four quarto volumes, in two columns, and will have from five hundred to seven hundred illustrations in each volume. In his preface, M. Havard says that the collection of the materials for this work, the researches and preparatory studies have demanded nearly ten years. This is not at all unlikely, considering the care and attention paid to details that one finds in every article. The author has delved amongst all the memoirs, all the journals, dictionaries and inventories century by century since the fourteenth, and it is from Froissart, Clement, Marot, Rabelais, Brantôme, Sévigné, D'Argenson, etc., that he has extracted instruction.

His object was to complete and, where possible, rectify the celebrated work of Viollet-le-Duc upon the furniture of the Middle Ages. This dictionary, to judge by the first volume which has just appeared, and includes the letters A to G, will be valued by the learned, by men of letters, archæologists and artists. Here gathered together and disengaged from every detail which does not refer directly to the word sought, are facts and documents, to discover which for himself would demand enormous time and numberless searches on the part of the artist or the inquirer who has need of it.

The practical side, without being absolutely neglected, occupies a more modest place in this work, which is written rather from the historic and anecdotical standpoint. In this respect the dictionary of M. Havard is very complete and exact. It is at the same time as interesting and amusing for the serious artist as for the amateur. Every word has its history and its complete genealogy — sometimes a little too long. In confronting so serious a work and such conscientious efforts, one experiences a scruple in risking any criticisms, especially before the work is complete, and consequently cannot yet be judged as a whole. Nevertheless, it may be allowable to point out at the present time the somewhat excessive agglomeration of details of quite secondary interest in certain articles considered and the brevity of certain others. The absence or the multiplicity of documents relating to these articles may be the cause of this, but the author might have been able to prune and condense a little more in some cases. The criticism of such works is a very delicate task; being addressed to everybody, that which seems useless to some may be precious to others, and M. Havard could answer complaint by citing such or such groups of artists, curiosity mongers, or investigators, for whom the very things which are considered valueless become the best of qualities. Thus, in order not to risk imposing an opinion which may not be shared and giving voice to an unjust judgment by looking at the matter from a point of view altogether too special, it is perhaps preferable to take certain articles in the dictionary and show in what manner they are treated. Let it be then two words of different characters — that of a movable utensil in daily use, such as a knife, and that of a portion of a habitation — a chamber. I choose these articles with intention. The first is a detail and occupies relatively a modest place in the ranks of furnishings; the second, on the contrary, the chamber, incloses a quantity of indispensable accessories which form the whole. It is interesting, therefore, to see how M. Havard has treated these two articles, and by applying the same method to other articles, one can more easily take cognizance of the utility and value of the work.

To the word "knife" have been devoted twelve columns and twenty drawings, and yet the author, leaving one side all the different applications of this utensil, has limited himself to mentioning the adaptations which strictly concern furniture and present a direct contact with the service of the table and the toilet. The article commences with a little history of the guild of cutlers, which, in the thirteenth century, was divided into two communities, one manufacing blades and the other handles. This separation did not long continue, and the two professions were united in the first half of the fourteenth century. At this time the richness of knives was already considerable. If proof were necessary, one could turn to the inventory of King Charles V, in 1380, where knives are mentioned in whose make-up enamelled gold, ivory and silver-gilt played the prin-

[1] "*Dictionnaire de l'Ameublement et de la Décoration*," par Henry Havard. 4 vols., flexible binding. Price, $40. Paris: Maison Quintin.

cipal part. Here, too, is a description of a personage who was styled the master of carving and the ceremonial surrounding this personage, as well as the rules which regulated royal and princely tables during the fourteenth and fifteenth centuries. The form and color of the knives are quite curious: thus, the color of the handles was not the same during Lent as at Easter, nor at Easter as at the Passover. This curious custom is supported by numerous documents, and M. Havard cites some which emanated from Etienne de la Fontaine, silversmith to King John (1352), the accounts of Geoffrey de Fleury and Guillaume Brunel, silversmith to Charles VI (1387).

The historical and anecdotical side is treated profoundly, thanks once more to information derived from the trousseau of Marie de Bourgogne, countess of Cleves (1415), the inventory of the Château d' Angers (1471), etc. It is thus that we see amongst other things that the first personage who had any idea of rounding the point of a knife was Cardinal Richelieu, compelled to endure at his table the Chancellor Seguier, who ate in a most improper way and picked his teeth with a knife. Richelieu invented, the story goes, this means of preventing the Chancellor indulging before him in this ignoble practice. From that time all knives were made round-pointed.

From the seventeenth century they began to manufacture knives especially made for cutting fruit, as is stated in the inventory of the Baroness Castelmauron (Toulouse, 1668). Finally, the author speaks of toilet-knives, which, from the fourteenth century, were employed for cutting and cleaning the finger-nails. The eighteenth century substituted the pen-knife for the case-knife for this useful task. Then the file took the place of the pen-knife. Finally, in the eighteenth century, appeared on the toilet table of the ultra-fashionables a knife to scrape off face-powder. These little instruments were extremely rich in design; that of Madame de Pompadour had a lacquered handle, and the blade and ornaments in gold. Finally, the article closes with a few words on the modern paper-knife.

We see by this epitome how complete is the treatment of this article and with how many documentary proofs the author supports himself. What will they be then for a more important subject, such as is the chamber. Forty-eight columns — quite a small volume — are consecrated to it, and eighteen engravings, four full-page plates in color. And first of all comes the history of the word itself, and its meaning at different epochs. Formerly it designated indifferently all the rooms of a house; thus one said, "the king's chamber," "the bathing chamber," "the tapestry chamber," etc. This manner of designation persisted for generations. In the seventeenth century the "blue chamber" of the beautiful Julie D'Angennes was celebrated amongst the habitués of the Hôtel de Rambouillet. In our time the custom is continued, and in the châteaux they still designate the chambers by their color or the nature of the hangings; but the one chamber with which M. Havard concerns himself in his dictionary is the bedchamber, the room in which, throughout all time, people have slept.

In the feudal habitations of the fourteenth and fifteenth centuries we encounter two distinct kinds of chambers, although both are bedchambers — the *chambre de parade* and the *chambre au giste* still smaller. Charles V, ill in the Château de Beauté, suffers and is cared for in the *chambre au giste* upon a narrow palette, but when his last hour is near he is carried into the swell chamber and placed upon a grand ceremonial bed, in order that he can draw his last breath with becoming dignity and surrounded by the paraphernalia that comported his rank. This digression upon the rôle which the chamber used to play, in spite of its curious and interesting side, is a little too long.

In the sixteenth century, the separation between the spare chamber and the ordinary chamber disappeared—at court, at least, where the kings and queens used to admit a crowd of courtiers at their awakening or their rising from bed. Everybody knows how important in the time of Louis XIV was held the favor of being present at the rising or couching of the king. This singular promiscuousness brought about a transformation in the furnishing of the chamber: there was first the "*ruelle*," a free space arranged under the curtains and draperies between the bed and the wall; then the "alcove," which was imported from Spain, but which was not at this epoch the recess to which we have since given this name. The alcove at that time consisted of columns and balustrades, which divided the chamber into two unequal parts: in the smallest was the bed, the priedieu, some chairs, etc. Then follows a rehabilitation after the most authentic documents relating to the furniture and the arrangements of the chambers of a certain number of illustrious personages, lords and ladies: Jeanne de Bourgogne (1316); Queen Clemence of Hungary (1328); Marie de Bourgogne, countess of Cleves (1425); Louise of Savoy (1525); Catharine de Medici (1589); Gabriel Destrées, Madame de Maintenon, Madame de Pompadour, etc.; and on the masculine side, Louis XIV and Louis XV. The list is a long one. These names give opportunity for very interesting historical and anecdotic details, but the author stops suddenly, and it is only by three engravings, representing a chamber under the Restoration, that of Mlle. Mars, a celebrated actress, and that of the Empress Eugenie at St. Cloud, that one can derive some contemporaneous instruction which gives opportunity for comparisons of much interest.

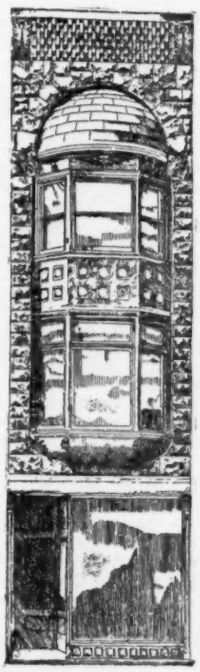
We see by these two examples that practical questions have been set aside. Under the article "Assemblage" we find, it is true, what is a mortise and tenon joint and what a dove-tail joint, but with this exception such articles are rare and they are also treated very briefly. It is always the anecdotic side which receives most attention. We learn, for instance, that elevators, which are generally believed to be of recent invention, have been employed in houses for more than two centuries. They were in use in 1660 at the court of Savoy. This apparatus was introduced in France by the Sieur Villayer, a man full of invention and much intelligence. Says St. Simon, "It is he who invented those *chaises volantes*, which by their counterpoise of weight rise and descend between two walls to the story where one wishes to go while seated within. Madame la Duchesse, the king's daughter, wished to have one for her entresol at Versailles. Wishing one evening to ascend, the machine stopped short half-way up, so that before they heard her screams and could release her by breaking through the walls, she remained there a good three hours. This mishap caused the apparatus to pass out of fashion."

In fine, the "*Dictionary of Furniture and Decoration*" is a work carefully done from every point of view. We only incline to complain that it embraces too long a period of time for the author to be able, in four volumes, to treat all the articles, taking care to preserve their relative importance and interest, in a complete and equal fashion. Such as it is, nevertheless, there may be found in it curious, interesting and, especially, exact information. It is only fair to add that the author and publishers recognize the obligation in which they may be placed of exceeding the number of pages or volumes prearranged, which would not, however, bring about any augmentation of the price of the work to the subscribers.

The illustrations are carefully made, and the drawings are scrupulously exact. As to the full-page plates, the greater part are in color and have been reproduced by a new process of chromo-typography. There will be sixty-four of these for each volume, or, at least, two hundred and fifty-six for the entire work.

## ARCHÆOLOGICAL NOTES.

ROME, January 17, 1888.



Store at Buffalo. I. H. Kent, Architect.

THE controversy raised among the archæologists by the finding at Rome of a chapel (*sacrarius*) dedicated to the worship of Mithras is not yet exhausted. This important discovery was made in the vicinity of Termini under the constructions which, according to the inscriptions, belonged to the Nummi-Albini family.

Without pretending to settle the controversy, I will state the principal elements of it. The existence of the worship of Mithras at Rome was already proved by several other objects. In 1864, some fragments relating to this Persian divinity were exhumed at Ostia, at the mouth of the Tiber, in the buildings of Pius Antonius. The Mithriac had even cleared the walls of the ancient metropolis of paganism before Christianity had definitely supplanted it, towards the third or fourth century of our era, and positive traces of it have been found at several other points of Europe, notably in Transylvania and ancient Germany. Some doubts still existed as to the real character of the Asiatic myth. The Greeks and Romans believed that Mithras symbolized love as the principle of fecundity and procreation which perpetuates the living world.

The painting that ornaments the recently-found chapel will aid us to settle the opinions on this subject. This painting represents the taurobolium. Mithras seizes with the left hand the victim's nostrils, whilst with the knees he keeps down the body as though he wished to master it. The right arm, which probably held a dagger for the killing, has been worn off by time. All that we see are the hind legs and a part of the back of the dog representing Sirius, guardian of the heavens and regulator of the year, but we divine by the posture of the legs that the dog leans towards the wound of the sacrificed beast in order to lick his blood. The bull's tail, although besmeared with earth, appears to be still ornamented with a bunch of spike, symbol of the year's fertility. On each side of Mithras there are two torch-bearers, one holding his flambeau turned towards the ground, while the other raises his to heaven.

Mr. Capannari, who has written a great deal about this highly important archæological object, and who has just died greatly regretted by the scientific world, saw in the lampadaire's different postures an allusion to the spring and autumn equinoxes, which mark the sun's coming and departure. Mithras wears the Phrygian miter and the red mantle (caudys). According to Mr. Capannari's interpretation, the Greek and Roman idea of Mithras, which made him the incarnation of the sun, was the true one, but this eminent

archæologist expressed the opinion simply as an hypothesis and certainly had no pretension of having closed the debate that has so long agitated learned societies.

Here is a list of the latest discoveries made by the Italian excavating committee:

At Rome an inscription has been found in the Cœlian Hill which probably has some connection with the epoch of the reëstablishment of the colleges, in virtue of the Claudian law of the year 696. In the neighborhood of the Via Cavour they have unearthed a fragment relating to the restorations made by order of Flavius Philip of a nymphæa existing in that quarter.

At Tivoli a Hercules has been found in a well-preserved state. By its elegance and the finish of its forms it belongs to one of the best epochs of Roman art.

In an old Capuchin convent near Verona, a collection of wine amphoras has been discovered, and some of the vessels still contained a pitchy liquid, whilst a fragment of polychromatic mosaic is reported from the vicinity of Policelle, on the Po.

The Superintendent of Excavations at Bologna reports an important discovery in the shape of a series of sepulchres of the first Christian epoch, some of which belong to persons of distinction, to judge by the richness of the accessories with which they were ornamented.

But it is above all in the Etruscan region that the researches have given excellent results. In the Bolesena and Orvieto zone, as well as in the neighborhood of Arezzo and Civita Vecchia, some very profitable excavations have been made; a great number of tombs have already been dug out, and it has been shown that the Etruscan burial places were much more extensive than has hitherto been supposed. The objects discovered have not yet been definitely catalogued, for they relate to an uncertain and little known historical epoch. The archæologists are not yet agreed upon the various periods of Etruscan art, and the objects that are ordinarily founp in the tombs, such as arms, amphoras, lamps, cups, jewels and other accessories, give only insufficient indications of the periods to which they should be attributed, although the degree of nicety and the perfection of the artistic embellishments may generally be considered as characteristic of certain centuries.

H. M.

## WATER-COLORS BY JOSEPH LINDON SMITH AT THE BOSTON MUSEUM OF FINE ARTS.

THERE is now, and will continue to be until February 22d, an exhibition of water-colors by Mr. Joseph Lindon Smith at the Museum of Fine Arts, which is more worthy of attention than the work usually brought to the notice of the public. There are some sixty numbers in all, the larger part of architectural subjects, though there are many pencil studies from old masters and from life and several landscapes. The work is that of a painter, not of an architect, as is manifest by the facility of the technique and by the attention devoted to the varying tones and delicate tints with which time clothes architecture, in contradistinction to the clearness of outline and of light and shade which to an architect appear paramount. Not that purity of outline or that chiaroscuro are at all lacking in these drawings; on the contrary, they are wonderfully rendered, but that the painter leaves out nothing, while the architect usually forgets the accidentals, and by so doing becomes more topographical and less interesting except to his own ilk. It is the fact that these water-colors render *everything* that makes them so remarkable — everything in the best sense of the word, not only drawing, color, sense of material, but that much better thing, the spirit and quality of the thing portrayed. The technique is certainly eclectic. It shows no strong leaning to any school. There may be a taste of the Paris atelier, but it is slight. There is a suggestion of the methods of the devotees of Ruskin, but the work has much more vigor than the emasculated productions of those disciples. Whenever a copy is made from an old master, the quality of that master is wonderfully reproduced. Here is evidently a man with his eyes and his heart open to be impressed and a hand skilful to record the impression, and yet he is not an impressionist (so called). The drawing is exact, yet without dryness, and is absolute in its fidelity in most cases. We remember going to the London water-color exhibition on Bond Street a year or two ago and coming away with a dreary distaste for painfully-labored, bloodless inanities, and then going into an Exhibition of American water-colors a few doors farther on and coming out with an irritation at badly-drawn specious cleverness.

These works of Mr. Smith belong to neither of these classes. They are skilful in drawing, beautiful in color and show a mastery of technique.

It is hardly in our province to speak of anything except the architectural work, but we cannot resist the temptation of calling attention to No. 7, a pencil study of Rubens, "Chapeau de Paille," and the pencil studies Nos. 18 and 46 after Rubens, No. 26 after Holbein, No. 32 after Velasquez. In as few lines as possible, with but little shadow, and with a peculiar softness and richness of touch, these studies render the fleshiness and color of Rubens, the restraint and austerity of Holbein, the breadth and vigor of Velasquez.

In a remarkable way, No. 10 — a small color study of Bonafagios, "Lazarus at the House of Dives," in the Academie dei Belle Arti in Venice — gives an excellent sense of one of the most wonderfully colored canvasses in the world. The portrait of a choir-boy in oils, has the simplicity and quietness of key of color of an old master.

Of the architectural work, which gives the warmth of Venetian, Italian color with its co-existent delicacy, not with the garish brutalities so prevalent in Venetian views, No. 31, west front of the Cathedral, Verona, is one most worthy of notice. The quality of the stone in reflected light (the subject was painted with the light reflected from the pavement of the piazza), the stained surfaces, the rich glow of Verona marble are all expressed in a masterly manner. This glory of color, this wealth of opalescence is produced from a very limited palette, only four colors being used, *i. e.*, cyanine, aureolin, yellow ochre, rose madder, with Chinese white as a vehicle at times, when the chalky bloom on the surface of marble was desired. This subtile commingling of four colors prevents the possibility of a crude tone. No. 18 — "Archway," S. Toma, Venice, in which the detail of the arch is beautifully drawn. Nos. 21 and 28, "Studies of Venetian Arches," with the most delicate subtility of line and gradation of color. Nos. 2, 3 and 4, "Venetian Wells," with very able drawing, the character of the carving of each type felt *for* each type. Besides these, No. 30 has fine drawing and delicacy almost reverence of touch, and the capitals to the pedestal of the Colleoni statue, No 20, are exquisitely drawn. This is only a hasty survey of the work and inadequate in its analysis, but that the work is of unusual character, is manifest at once upon seeing it.

## COMMUNICATIONS

### THE DECORATION OF McVICKER'S THEATRE, CHICAGO.

Chicago, Ill., February, 1, 1888.

To the Editors of the American Architect: —

*Dear Sirs,* — We are led to reply to Mr. Twyman's note in your issue of January 28, solely for these reasons: First, to relieve Mr. Blackall from the embarrassment of an apparently false position; second, to protect ourselves and our profession. For we feel that such irresponsible statements, allowed to go unanswered, cannot be otherwise than detrimental generally to those of us with whom architecture is a loved and cherished art.

We beg, therefore, to say, that Mr. Blackall is thoroughly right in his statement that the decorative work in McVicker's Theatre, Chicago, was executed from our designs; and Mr. Twyman is thoroughly in error when he claims credit for the same. In Mr. Twyman's statement, however, there is a faint suggestion of truth which will be clearly understood, we think, when it is made known how Mr. Twyman, who, at the time of the remodelling of McVicker's Theatre, was a salesman in charge of the retail wall-paper and interior-decorations department of the extensive wall-paper house of John J. McGrath, Chicago, plays upon the meaning of the word decoration.

The architectural treatment of the interior of McVicker's Theatre is based upon a single consistent scheme or plan which is differentiated into form, color and illumination. The transitions and interblendings are subtile; and we deem it evident to the critical observer that the conception is identical throughout form, color and illumination.

The decorations, as we understand the term, take their origin in certain changes of form initiated in the constructive subdivisions of the design. This tendency toward change gathers increased definiteness as it passes through certain geometrical ramifications, and, taking on swiftly but without abruptness an organic semblance, culminates finally in intricate and involved folliation and efflorescence. Within this work, and incidental thereto, are placed the bulbs of the incandescent system of illumination. This method of treatment applies to the proscenium with its large sounding-board and twelve boxes: the whole converging toward the stage-opening and elaborately framing the same. It applies also to the main entrance vestibules. For this part of the work we not only made the designs, but we furnished carefully worked-out full-size details, even for the foliated work, which were most faithfully and without the slightest deviation carried into execution by James Legge, the carver, with whom the contract for the same was placed. Inasmuch as this work, executed in plaster, was completed, stored and covered by an insurance policy prior to our entertaining the idea of asking sketches and bids for color decoration from decorative concerns, it is manifest that neither Mr. Twyman's conception nor handiwork nor supervision entered into this part of our operations.

Considerations of economy necessitated that the remainder of the auditorium and its appendages should be treated very simply, we, therefore, at the time the general contracts were let, did no more as regards appearances, in addition to the purely utilitarian and acoustic handling, than to definitely determine the number and approximately the location of the electric-light bulbs and the inlets for the supply of fresh air for the fans.

When the time approached that the contract for color decoration should be considered, we began anxiously and carefully to think of the coloration, for it became distressingly evident that the delicate rythms and modulations of the plaster ornamenation, now in place,

would be deprived of their sequence, significance and context by an inadequate or bizarre scheme of applied color. Gradually then arose the conviction that the structural, the geometrical and the foliated parts could not be given relative color values which should differ essentially from their relative solid values, lest, through false accentuation the equilibrium and repose of the single simple idea or impulse underlying the conception be disturbed, and thwarted of its full expression. From this sense of balance followed logically the belief that these parts should be in close and delicate self-tones; and, finally, the determination that the principle of gradual and smooth change carried out in the design should also be the dominant idea in coloring. Upon reaching this decision, or rather, as it would seem, reverting to the original conception of the whole, we made known our idea and wishes to Mr. Twyman and to other decorators, and asked them for sketches covering the unfinished parts above referred to, and for schemes and prices for the color-work of the whole. Mr. Twyman was the only one of these who submitted a proposal in accordance with our suggestion (the choice of color as between many desirable and befitting ones was left open). His choice of color and treatment was in the main sympathetic with our architectural treatment, and to him, or, rather to his principal, John J. McGrath, the contract was awarded. Here, then, we begin to discern the first awaking of Mr. Twyman's conception. Let us progress a step nearer to it.

Mr. Twyman proposed to use for the wall-covering a wall-paper which we had designed, full-size, for Mr. McGrath some two years previously. The pattern of this paper required six or seven blocks twenty inches square for its development, and as it had the characteristic movement we were glad to use it in this house. Mr. Twyman proposed to heavily flock the pattern, and to add a raised rosette to the centre of the flower. This suggestion was accepted. To use this paper was Mr. Twyman's own thought: we had utterly forgotten its existence.

There now remains for examination only the flat part of the main ceiling, the ceiling under the gallery and under the balcony, and the *foyers* and retiring-rooms, which are small. For these were required flat treatment in paper, bits of *papier-maché* foliated work at the electric-bulbs, and the limited amount of stencilling called for by Mr. Twyman's sketches. In actual execution, these forms seem to us, as they must to any skilful and discerning eye, to possess that peculiar suggestion of caricature that the ear notes in the speech of a foreigner uttering our native language neither grammatically, musically, nor with deft and rythmic enunciation. The plastic forms here are Mr. Legge's execution of an already beheaded conception, which, in that condition, is assuredly the exclusive property of Mr. Twyman. The stencil patterns were carried out full-size by the foreman on the work. The great pressure and rush of the whole undertaking toward completion, unfortunately made it impossible for us to give the time to a revision of these designs.

As to Mr. Twyman's statement, "The work was executed under my charge and dictation, and was my own conception without control of architect or owner," this is manifestly absurd; for the work was done under our regular form of contract. This contract was between John J. McGrath and J. H. McVicker as principals, and contained the customary stringent clauses regarding the supervision and rejection of work by the architects, payment upon acceptance and certificate, etc. These powers were used. Mr. Twyman represented his principal at the building in the capacity of overseer or superintendent, or what-not, or as what is known in the trade parlance of these houses as their "artist."

This is a correct statement of the case. How, then, shall we understand the full scope and content of Mr. Twyman's connection with this work otherwise than by applying to the language of his note his evident "conception" of the meanings of English words.

Very truly yours, ADLER & SULLIVAN.

## BAND-SAWS FOR LARGE LOGS.

MISHAWAKA, IND., Feb. 1, 1888.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

*Dear Sirs,*—In connection with your item about California Redwood, *American Architect*, January 28, it may be of interest to you to know that Lonaon, Berry & Orton of Philadelphia are building band-saw machines capable of sawing redwood logs ten feet in diameter. Respectfully, R. D. O. SMITH.

## TESTING FOR THE FOUNDATION OF THE CONGRESSIONAL LIBRARY.

CLEVELAND, O., Feb. 6, 1888.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

*Dear Sirs,*—As I have just finished Mr. Smithmeyer's article in the last number of your journal, I would like to occupy enough of your valuable space to say a few words more upon the subject. My sketch was made from memory as Mr. Smithmeyer suggests, but with the exception of the movable car I do not see but that it was substantially correct. Unless my memory utterly fails me, the track upon which the car runs rested upon either six or eight pedestals, although the car was directly over four of them. Also the pig-lead was piled much higher on one corner of the platform than elsewhere. My idea of the apparatus was that it was intended to ascertain the load that a square foot of the soil would carry for a constant settlement, and not as I find it, to determine the amount of settlement for a constant load. For the first of these purposes I think that my objections would hold. As it had been raining all day when I visited the site, I obtained a very good idea of the character of the soil from the large amount of it which accompanied me upon my departure. Thanking Mr. Smithmeyer for the courtesy of his answer and hoping that he will understand that I was not responsible for the heading of my communication, I remain very respectfully yours,

CLARENCE O. AREY.

## THE ALBANY ASSEMBLY-CHAMBER VAULT.

NEW YORK, Feb. 7, 1888.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

*Dear Sirs,*—I beg leave to direct your attention to the report of the experts who a few days ago advised the immediate tearing down of the vaulting of the Assembly Chamber at the Albany Capitol. My researches into the matter issued in your paper October 29, 1881, and March 29, 1884, having been fully justified in spite of all attacks, I should like to learn what steps you are going to take concerning this affair, which at all events should be used to show that science and truth are above political tricks and "bossism."

Truly yours, H. W. FABIAN.

## IRON CHURCHES.

NEW YORK, N. Y., February 7, 1888.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

*Dear Sirs,*—In your issue of February 4, 1888, page 60, you suggest that I can give information as to the builders of iron churches, and add a supplementary paragraph of what a correspondent reports Ruskin as saying.

Will you be kind enough to state in your journal that the last iron church was erected in 1873, that not one has been built since, and that no one need apply to me for any further information relating to building iron churches. Very truly, LAWRENCE B. VALK.

## NOTES AND CLIPPINGS

A ROMAN SANATORIUM.—An important discovery has just been made at Susa, about six miles from Castelforte, which points to the conclusion that the Romans were acquainted with the use of mineral springs for medicinal purposes. The erection of new mineral baths is contemplated in that spot, and during the work of excavation the remains of what proved to be old Roman mineral baths have been met with. A road paved with Basaltic lava separates the two principal groups of buildings. To the left of this road, and leaning against the mountain side, is the bath for hot mineral springs. The atrium is entered, as in classic dwelling-houses, through a portal adorned with columns, its floor being laid in black and white mosaic, and its roof probably formerly supported by four columns. Between these columns is the impluvium, a square marble basin, round which are seats, which leads to the supposition that it was used for bathing purposes. In the middle of the impluvium a hollow marble column supported a smaller basin of alabaster, into which the water rose through the column, flowing over its edges into the large basin. The further wall of the atrium opens into a large hall; through its side walls corridors lead into chambers to the right and left, the use of which for bathing is indicated by the whole arrangement of water basins and a network of water conduits, some of which are placed in the walls. On the other side of the main road, with a view towards the river, two buildings are located, in front of which a row of columns with walled parapet probably inclosed a garden extending along the river bank. Between the two buildings, containing rooms of various sizes, all of which give into outer corridors surrounding them, a colonnade provided with seats has been erected. It is concluded that this group of buildings formed a hospitium or inn for the bathing guests—that is to say, a hostelry for those staying for their cure. The purpose of the whole establishment is also shown by the condition of the statuary in the atrium, which has been much injured by the mineral water. The sanatorium must have flourished for a long time, for, together with coins of Augustus's and Vespasian's time, Arabian and Norman gold coins have been found.—*Sanitary Record.*

THE WORLD'S DEEPEST WELLS.—The deepest well drilled in the United States is that of George Westinghouse, at Homewood near the city of Pittsburgh, which, on Dec. 1, 1886, had reached a depth of 4,618 feet, when the tools were lost and drilling ceased. The Buchanan Farm well of the Niagara Oil Company, drilled by Frederick Crocker in Hopewell township, Washington county, is 4,303 feet deep. The Rush Well of the Niagara Oil Company in Washington county was abandoned at 3,300 feet. The deep well of Jonathan Watson, near Titusville, was drilled about 2,500 feet. J. M. Guffey & Co's well on the Walz farm at West Newton, Westmoreland County, was drilled to a depth of 3,500 feet. The well of Isaac Willets at Sargent's Mills, near Sycamore, in Greene county, was abandoned at 3,008 feet. The deepest bore hole in Europe is at Schladebach, near Kotschau station, on the railway between Corbetha and Leipzig, and was undertaken by the Prussian Government in search for coal. The apparatus used is a diamond drill down the hollow

shaft of which water is forced rising again to the surface outside the shaft of the drill and inside the tube in which the drill works. By this method cores of about fifty feet in length have been obtained. The average length bored in twenty-four hours is from twenty to thirty-three feet, but under favorable circumstances as much as 180 feet has been bored in that time. Other deep holes are as follows:

| | Feet. |
|---|---|
| Domnitz, near Wettin | 3,287 |
| Probat-Jesar, Mecklenberg | 3,957 |
| Sperenberg, near Zossen | 4,176 |
| Unseburg, near Stassfurt | 4,242 |
| Lieth-Elmshorn, Holstein | 4,390 |
| Schladebach | 4,515 |

— *The Progressive Age.*

Brick and Stone Bridges of Large Span. — According to Professor E. Dietrich, of Berlin, there are only fifty-seven bridges, of brick or stone existing having a span greater than 131 feet. Forty of these have spans lying between 131 feet and 164 feet, ten have spans of from 164 feet and 200 feet, three of from 200 feet to 230 feet, and one only, the Cabin John Bridge, near Washington, exceeds this limit, and has a span of 237 feet. Thirty of these are road and twenty-two are railway bridges; one carries a canal, another a conduit, and three are not classified. Fourteen of them date from before the commencement of the present century, twenty-two were built between the years 1800 and 1860, five between 1860 and 1870, six between 1870 and 1880, and since then ten have been erected. In twenty-two of the bridges the rise lies between half and one-third of the span, in eighteen between one-third and one-fourth the span, in ten between one-fourth and one-fifth the span, and in six between one-fifth and one-eighth the span. One bridge only, a road bridge in Turin, has a flatter arch than given by the smallest of the above ratios, and in this case the rise is $\frac{1}{8.18}$ the radius at the crown lies in fifteen cases between 66 feet and 98 feet, in eight between 98 feet and 131 feet, in eleven between 131 feet and 164 feet, and in three cases between 164 feet and 187 feet 8½ inches, the latter being the radius at the crown of the Devil's Bridge at Bevizzo, Italy. The ratio of the arch at the crown to its radius at the same point is in thirty bridges between one-tenth and one-twentieth, in ten between one-twentieth and one thirtieth, and in eight between one-thirtieth and one-thirty-fifth. In all the railway bridges this ratio lies between one-twentieth and one-thirtieth, the smaller fractions being solely confined to road bridges. Twenty-seven of the bridges are situated in France, thirteen in Italy, ten in England, two in Austria, two in Spain, and one each in Germany, Switzerland, and the United States. — *Engineering.*

A Bit of Chelsea. — Speaking of the Chelsea china factories, the London *Standard* says: "Time was when enthusiasts used to wait their turns for the crockery as it came out of the ovens, and Gay made merry over the lady whose rest could be broken by 'A cup, a plate, a dish, a bowl; China's the passion of her soul.' Even Dr. Johnson was affected by the prevailing mania, and not only bought the wares, but tried to fashion them himself. Yet, in spite of the furor for 'Chelsea,' and the high prices paid for it, the factory closed its doors, to the amazement of the public, who explained it by saying the porcelain people got their clay from the Chinese, who, when they found out the use made of it, refused to let the captains any longer ballast their ships with the precious material. Some of the Chelsea works of art were quite equal to the best of Sèvres ware, and nowadays they command prices which Sèvres does not always reach. In 1879, a tea-service painted with exotic birds brought nearly £900, the milk-jug alone selling for £71 8s, or about five times its weight in gold. Even the cups and saucers were sold at figures varying from £40 to £60 the pair. A vase two feet high brought £566; and at another sale, three little vases were disposed of for £1300. The late Lord Dudley bought the Chesterfield vase for £2000, and one which had stood for 100 years in the Foundling Hospital for a sum not much less."

Adventure of a "Steeple Jack." — A singular accident occurred at Slaithwaite, near Huddersfield, County of Yorkshire, England, on Saturday, which for the time caused a good deal of excitement. A very extensive cotton-mill has been erected for the Slaithwaite Spinning Company, and on Saturday, December 31st last, the chimney, which reaches to a height of one hundred and eighty feet, was so far completed that a "Steeple Jack" from Huddersfield was engaged to fix the lightning-conductor and remove the scaffolding which had been used to complete the chimney-top, round which there is a very wide parapet. The "Steeple Jack" successfully removed the scaffolding and was about to make preparations for his descent when the rope by which he was to descend somehow became detached and fell to the ground. The man was left on the chimney top. Soon a large crowd of persons assembled and they were for a time somewhat puzzled to know how he was to get down. The "Steeple Jack" was equal to the occasion and while the people were wondering how it was to be done, he sat busily engaged in unravelling one of his stockings, and when this work was completed, he let down one end of his thread and in course of time was provided with a rope sufficiently strong to let himself down by.

Moving the New York Capitol to Troy. — No; the State must look elsewhere for a spot whereon to erect a new capitol, one which can be sure of its foothold and its roof-tree alike. Our suggestion, made in all modesty, is, that the "monumental folly" be taken down, a portion of the stones transported to Troy, a building erected here for State Government purposes at the cost of $4,000,000 or $5,000,000, and the rest of the material sold to meet the expense. We are not sure but that such a sale of the left-over material would be more than sufficient to foot every bill and leave a surplus equal to the public debt of the State. — *Troy Times.*

Reappearance of a Submerged Chinese City. — The city of Naiyen, north of Ningpo, which was submerged about 1000 years ago, has recently been exposed to view and a number of vases, plates and other utensils of the Sough dynasty have been recovered by the natives.

## TRADE SURVEYS

If there are any influences at work in American and European trade and manufacturing circles to decrease the volume of business or the output of mills, mines or factories, or the traffic of railroads or of ocean tonnage, they are not on the surface. In fact, there is no broad-guage reason to be given why any decline in activity of any kind should take place. Those who are using microscopes to discover evidences of worm-eating going on in the foundation timbers of our business structure have been unable to find them. There is no dry-rot in progress. A good ventilation is maintained throughout the entire business structure from the basement to the finial. In fact, there is nothing going on or there is no growth possible that should obstruct the natural and orderly development of this nation or any other nation, and the wisdom theoretical and practical, which is the common property of all, will prevent the growth of evils which could bring about distressing results. In short, business is good, trade picking up month by month and year by year, manufacturing and railroad-building enterprises are increasing, and developments of all kinds are feeding on healthy material. There is nothing to alarm, but there is a great deal of work which calls for the highest order of business and commercial management. One of the strongest, and at the same time weakest points within our reach, is the abundant supply of money. That abundance if rightly used will swell the volume of business and strengthen the body politic in every fibre. If it is wrongly used, it will create paralysis and congestion or some other evil that will not be likely gotten rid of. Taking a brief sweeping survey of the various industries, we find the facts to-day to be about these. Architects in all our larger cities are not overcrowded with work but are busy. Builders in cities and towns are making extensive preparations for a year's activity, and they are buying to cover contract work already given. Their purchases cover iron, steel, lumber, stone, slate, glass, paper and everything used in the completion of our better class of building work. Those who have given particular attention to heavy work, such as bridge-building, heavy warehouse work, railroad work and the like, as well as engineering jobs, are nearly all in a good frame of mind over the requirements that have already been brought to their attention, and prospects for employment in the prosecution of heavy enterprises in all sections of the country. References have been heretofore made to the prospects of a number of important engineering enterprises, and every week brings out one or two more that will probably be prosecuted. It is impossible to say at this writing, with any certainty, as to what railroad-building will be done this year. Two weeks ago the hope was indulged in by many writers that the dead-lock between buyers and sellers of rails was broken, and that orders for one-half million or more tons would be crowded in. Up to this time only a half dozen roads have bought, and those mainly for trifling requirements, such as repairing or extensions. No contracts have, as yet, been placed for big work, such as for the construction of a transcontinental line or for any parallel roads. But we know there are several enterprises of this kind which have passed the ordeal of Wall Street. That is funds have been promised, bonds have been sold or are selling, and everything is being put in readiness for construction. The rail-mills have very little work in hand, and by the time spring opens they will be in a starving condition for business. The theory of railroad builders and rail-buyers is, that by that time the rail-makers will have reasons for accepting $30 to $30.50 as the bottom mill prices in Eastern Pennsylvania. All other branches of the iron trade are fairly active, excepting the pipe-makers. It is rather strange that this industry should be dull considering the facts and possibilities in store for transporting natural gas for domestic and manufacturing purposes. Car, locomotive and ship and boat-building will be very actively prosecuted all this season. Our advices up to within a few days show that nearly all yards along the coast and in the interior are pretty well loaded up with orders. Further discouraging news is received from a number of Western implement works. A few have been sold out, quite a number are working half time, but the stronger will survive. The industry will, in a few months, probably, be upon a stronger foundation. It has been overdone, and, naturally, a reaction will take place. The lumber trade is remarkably active this winter. Loggers in the Northwest thus far have been unable to bring out the usual percentage of logs, and this fact is being used as an argument in favor of higher prices next year, but the winter is not yet over, and the makers will, no doubt, have the usual supply on hand for the spring. Hard woods will be in abundant demand. Several new Southern woods are coming in. Sap-pine is taking the place of cherry. Yellow-pine is, to a considerable extent, taking the place of hard woods. Walnut is not in demand. Cherry, ash and poplar hold their own. The Western yards are pretty well supplied, and buyers, as a rule, are deferring the placing of large contracts until a little later. The possibility of a strike in the Wyoming coal region has put up prices 25 cents a ton. A further advance will take place within a week should the probabilities of a strike increase. The industries depending upon anthracite coal have not suffered excepting in isolated cases. The output of coke has been reduced, and two strong syndicates now control the entire Western Pennsylvania production. The bituminous coal production will be considerably increased this season by the extension of short lines of railroad into nearby coal-bearing territory. The commercial situation is very good, although the volume of business is below last January. Conditions are such that an increase in the volume of trade can be relied upon. Stocks are low in nearly all markets. Textile production is maintained at high points in all kinds of cotton goods. In woollen goods the prospects are better. In hosiery foreign competition is still causing a good deal of trouble. Money is seeking investment where it is safe. Speculation is doing but little mischief. Congress is playing with the tariff question, labor troubles, the surplus question and two or three others. The Third House has given it out that nothing will be done to jeopardize existing arrangements. In labor matters the striking miners at Philadelphia, the carpenters at Pittsburgh, the building trades at Chicago and some classes of labor in Cincinnati are causing a little anxiety to many employers as to friendly relations during the spring. In other cities labor organizations are discussing hours of labor and rates of wages, but advices from several authorities go to show that labor difficulties will diminish rather than increase during the next sixty days. Labor, as a whole, is anxious to arrive at an understanding and stick to it through the year.

S. J. Parkhill & Co., Printers, Boston.

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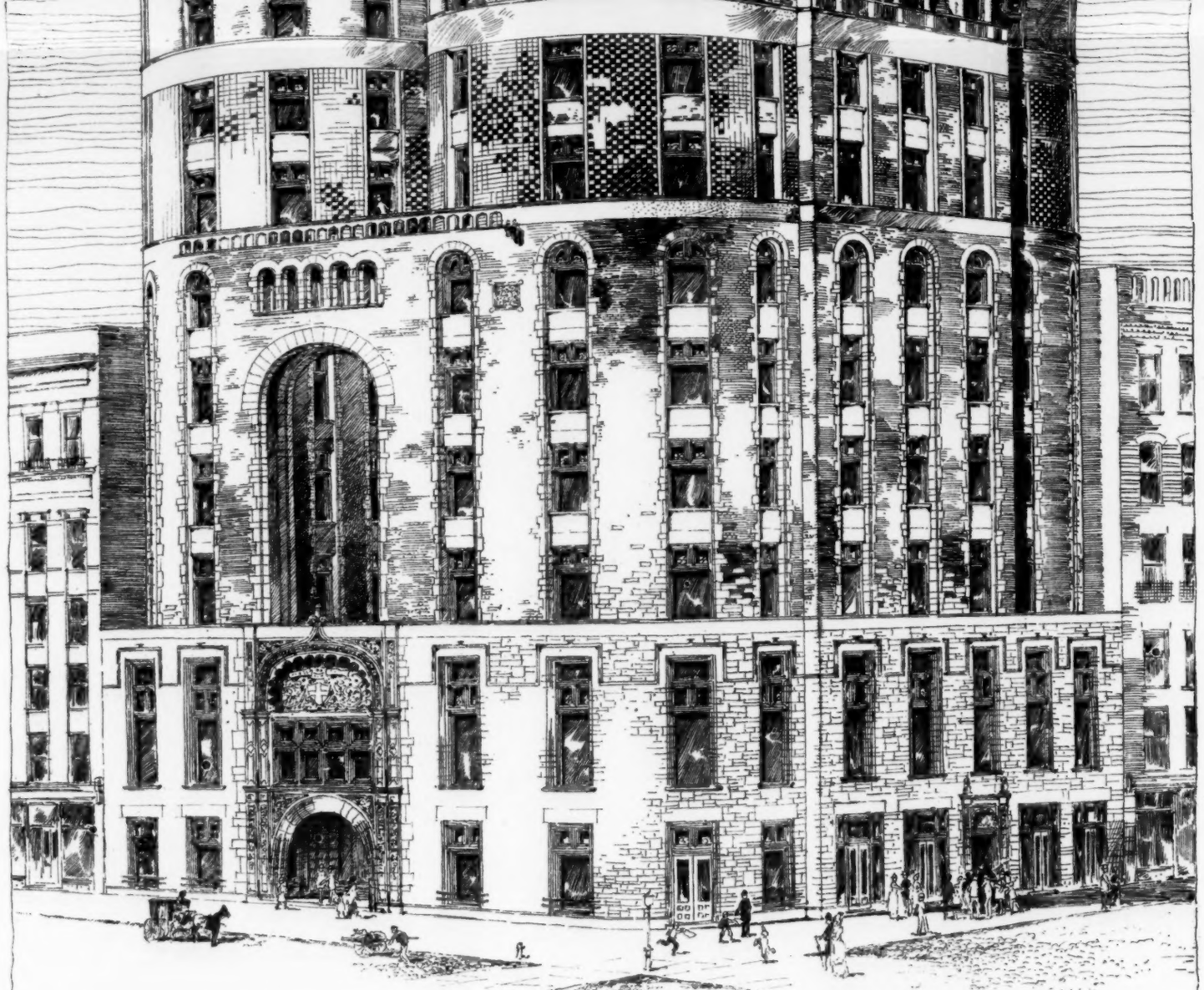

Design submitted for the New York Life Insurance Co's Bldg St Paul Minn March 17th 1887

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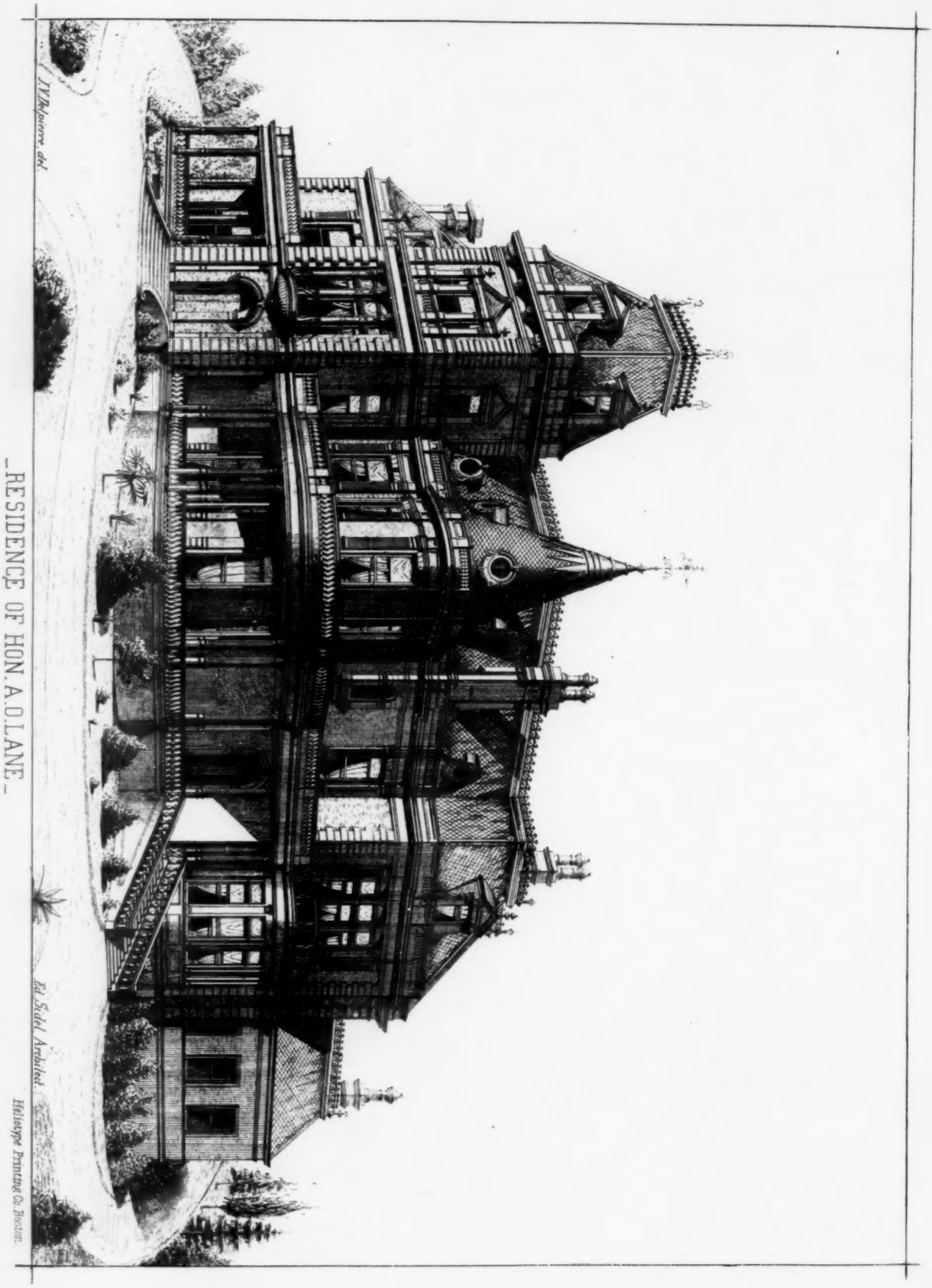


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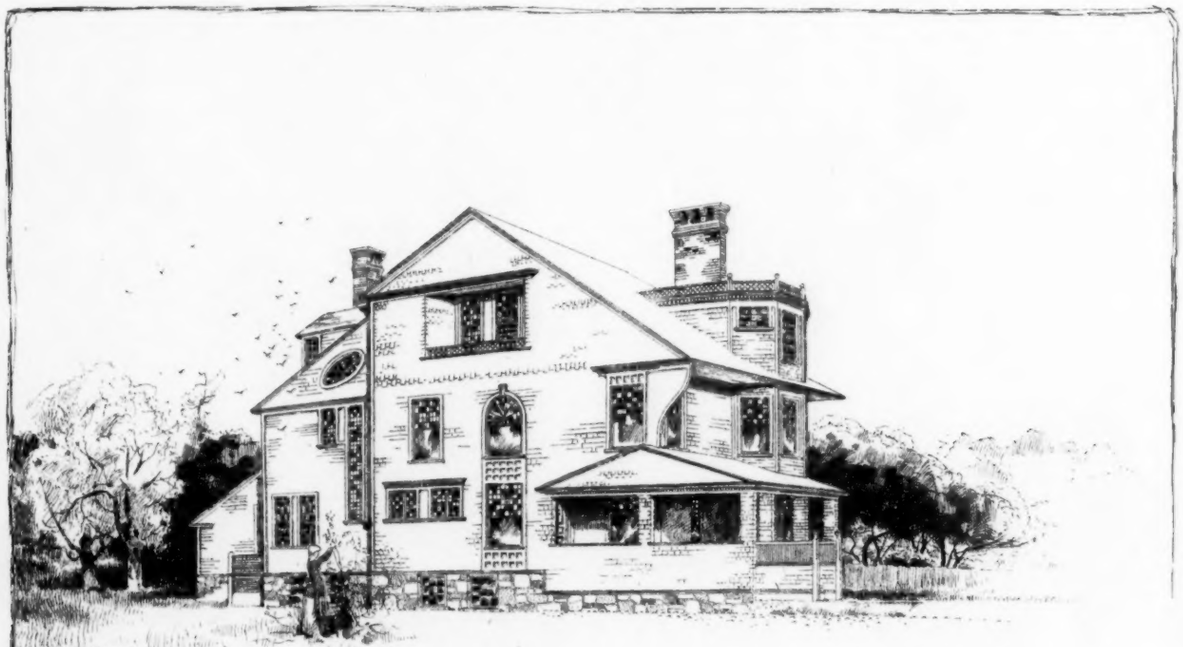

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